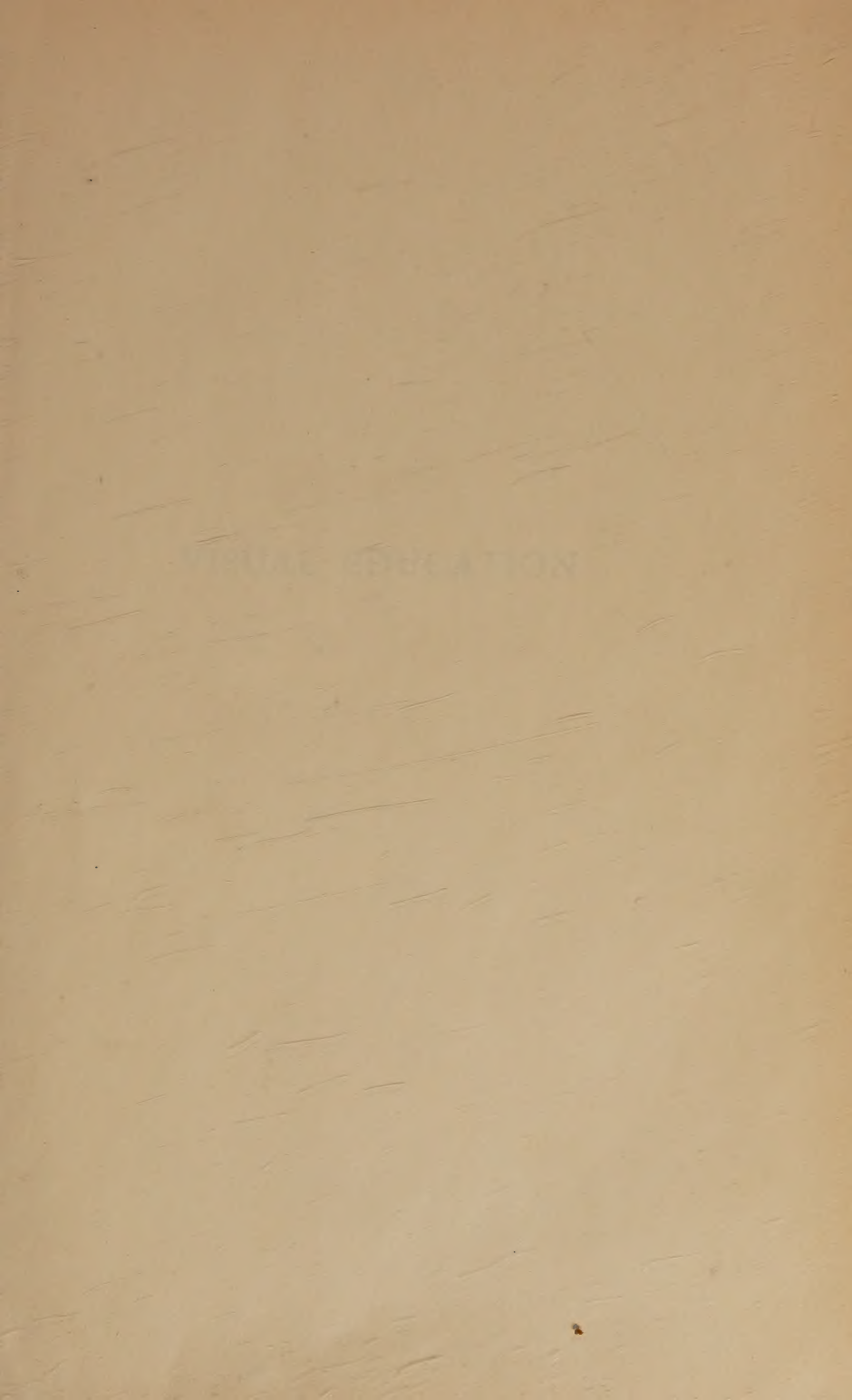




VISUAL EDUCATION

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VISUAL EDUCATION

A COMPARATIVE STUDY OF MOTION PICTURES *and* OTHER METHODS OF INSTRUCTION

THE REPORT OF AN INVESTIGATION MADE WITH THE AID
OF A GRANT FROM THE COMMONWEALTH FUND

By

FRANK N. FREEMAN

A. P. HOLLIS

LENA A. SHAW

F. D. MCCLUSKY

CAROLINE HOEFER

D. E. WALKER

H. W. JAMES

EDNA KEITH

NINA J. BEGLINGER

E. H. REEDER

H. Y. MCCLUSKY

JEAN A. THOMAS

E. C. ROLFE

Edited by

FRANK N. FREEMAN



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PREFACE

On April 1, 1922, the educational committee of the Commonwealth Fund granted to the University of Chicago the sum of \$10,000, to be used, under the direction of the writer, to support a study of educational motion pictures. The experiments which are reported in the following pages were made by means of this grant, during the succeeding year. They were carried on in the University of Chicago Elementary School and in the public schools of Evanston, Illinois; Urbana, Illinois; Detroit, Michigan; Cleveland, Ohio; Joliet, Illinois; and Chicago, Illinois. The authors of the several reports and the editor have joint responsibility, both for the experiments and for the reports.

It would be difficult, if not impossible, to acknowledge all of the assistance which has been generously given in the conduct of these experiments. It is hoped that the many who are not mentioned by name will accept this general acknowledgment. Special mention should be made of the following: Mr. D. E. Walker, Assistant Superintendent, Evanston; Mr. William Harris, Superintendent, Urbana; Professor A. B. Mays, University of Illinois; Professor W. M. Gregory, Cleveland School of Education; Mr. Dudley Grant Hays, Assistant Superintendent, Chicago; Miss Wiley, principal of Leal School, Urbana; Mr. B. A. Barns, principal of Angell School, Detroit; Miss Anne Dubelin, assistant principal, North Doan School, and Miss Ethel Dauss, teacher in Mt. Auburn School, Cleveland; the following teachers in Detroit. Miss Lillian Norconk, Doty, Miss Virginia West, Lingemann, Miss Catherine H. King, Columbian, Miss Kennedy, Condon, and Mr. McGuire, Miss Robinson, and Miss Lodge, Miller Intermediate. The investigation was also materially aided by the loan of motion picture films by the Society for Visual Education and the United Projector and

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Film Co., and by the gift of stereographs and slides by the Keystone View Co.

On account of the varied character of the experiments, and the large number of persons who conducted them, it appeared impossible to present a single report organized by topics, unless it should be written by one person. It was thought undesirable to thus sacrifice individual responsibility. The reports are therefore presented separately, but an organized summary of all of them is printed at the beginning.

F. N. F.

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PART I
GENERAL SUMMARY OF THE STUDY

CHAPTER I

INTRODUCTION: PROBLEM AND METHOD OF PROCEDURE

The first few years of the present century may be taken as marking roughly a turning-point in the mode in which changes are brought about in American Education. ♦ The feature of the new era which sets it off from those which precede it is the application of scientific methods to the investigation of educational problems. Before 1900 new subjects of study, new forms of organization, and new methods of teaching were introduced on the ground of opinion. They were opposed also on the same ground. Now proposed innovations, and established practices as well, must meet the challenge of the science of educational measurement, which stands ready to appraise them, not on the ground of opinion, but on the ground of objectively ascertained fact.

We need not review here the difficulties which attach to such scientific measurement nor the sources of error which thrust themselves upon our attention. The scientific student is painfully aware of these difficulties and sources of error, since it is his business to overcome them. Nor need we dwell upon the necessity of resorting to opinion—based upon careful observation and a recognition of general psychological truths—to supplement our as yet confessedly incomplete scientific studies. Granted all this, the real hope for consistent progress in education lies in the application to it of careful, painstaking methods of research.

The need of scientific scrutiny of the group of new methods or devices which go by the name of visual education is apparent on every hand. Visual education is relatively expensive, particularly in the form of motion pictures. At this time when school systems throughout the land are in dire financial straits, new and expensive devices must be examined with care. Extreme

and apparently extravagant claims are made for visual education. We are told that it will in whole or in part displace the teacher or the textbook, that it will speed up education tenfold, that it will make education absorbingly interesting and thoroughly permanent. Visual education is promoted by advertising campaigns which set forth the most grotesque arguments for the adoption, such as: "What goes in one ear goes out the other, but what goes in through the eye sticks, as there is no hole in the back of the head." If this is intended as humor, it at least indicates the level of appeal which its author believes is suited to the average school official.

The present investigation was undertaken in the belief that school administrators have sufficient confidence in scientific methods to be hospitable to a serious attempt to weigh the educational possibilities of visual education. The authors of this report disclaim any pretension of having finally and completely determined what these possibilities are. They do believe, however, that the experiments which they have made help to determine how fast the schools ought to go in adopting the present forms of visual education and in what direction the development of visual education should proceed.

WHAT IS VISUAL EDUCATION?

 There is something strange and unusual about visual education. Visual education represents a grouping of educational materials or devices and an organized department of instruction which is based, not upon subject-matter, but upon a method of presentation. This method has as its essential feature the fact that it belongs to one of the senses. Such a situation is without parallel. We do not have departments of auditory education, of tactual, kinesthetic, gustatory, or olfactory education. What is the cause of this unique position of visual education and of what does visual education consist?

We may get at the fundamental cause of the unusual situation in which visual education finds itself by glancing at its history. Visual education, in the broad sense of the term, is, of course,

not new. Models, maps, diagrams, pictures, all have been used for generations. Teachers of the various school subjects have developed materials and forms of visual presentation to be used in teaching their subjects. Geography and nature study have been represented by an abundance of such materials. There is now a strong movement toward the centralization of these materials and with this centralization has gone the agitation for the enlargement of its scope.

A number of conditions have combined to produce centralization. One is the development of elaborate museums in place of the small collections of models in individual school buildings. An example of such museums is the Field Museum of Chicago with the Harris Extension which provides distribution of specially prepared specimens to the public schools. A second condition favoring the centralization of visual education is the development of the extension service of the state universities. This service has emphasized agricultural education, but has also included general public education. A third factor is the organization of large companies which manufacture for use in the school the material equipment for visual education. This equipment may consist of models, charts, maps, projection apparatus, or material to be projected. The materials which have been most important in their influence on the development of visual education as a distinct agency in the school are stereopticons and slides, stereoscopes and stereographs, and last but not least motion picture projectors and motion picture films.

It is clear from this account that the centralization of visual education has arisen because of the exigencies of the production and distribution of materials rather than from the inherent unity of the field of visual education itself. Visual education, in fact, is extremely variegated in its subject-matter, its aims, and its materials and paraphernalia. A complete study of visual education, therefore, would lead us into the details of the teaching of all the subjects of the school. If we confine ourselves to the processes which go officially under the name of visual education and which are commonly administered by a centralized

agency, the complexity of our task is great enough. We shall then include as our chief subjects of study the three outstanding modes of pictorial representation, namely, slides, stereographs, and motion pictures. These, accordingly, are the chief subjects of our study, with the emphasis on motion pictures, on account of their newness and because their development is most susceptible to the influence of experiment.

GENERAL SCOPE OR RANGE OF THIS STUDY

In undertaking an investigation in any field in which comparatively little work has been done, one is faced with two alternatives. The first is to make a rather broad comprehensive survey of the entire field. The second is to make a more intensive study of certain narrow problems within the field. Each of these procedures has its advantages and its disadvantages. The broad general survey has the advantage of raising a variety of problems, of pointing the way to more specialized studies of these problems, and of contributing something to the solution of some of these specialized or narrow questions. The disadvantage is that many of the questions which are raised are left at loose ends, and no one problem is carried sufficiently far to reach a final solution. The advantage of the specialized investigation is that it does solve certain problems, but the attending disadvantage is that these problems are very narrow in scope.

In planning the present investigation the advantages of the broader type of study seemed to be sufficient to turn the scale in favor of this type. Consequently the study deals with a variety of examples of visual education and with a variety of questions concerning these examples. The nature of the experiments can best be grasped from a brief statement regarding the comparisons with which they are concerned.

TYPES OF COMPARISONS MADE IN THE STUDY

The investigation consists largely in a comparison between various forms of visual education or between visual and non-visual methods. We may first consider the types of presentation

which were compared with one another in the various experiments of the study. In the first group of comparisons, the material in the exercises which were compared was duplicated as exactly as possible. For example, if a motion picture film was to be compared with lantern slides to determine which was the more effective, the lantern slides were constructed so as to duplicate the pictures which were shown in the film. In a number of cases the lantern slides were actually made from selected frames in the film. This general procedure was followed out in all of the comparisons of this group.

One of these comparisons has already been mentioned. A motion picture film was shown to a group of children, and to another group was shown a number of lantern slides, duplicating sections of the film. In some cases accompanying verbal description which occurred in the subtitles of the film was presented orally to the class. In other cases the subtitles as well as the pictures were reproduced upon the slides. In these cases the slides containing the subtitles alternated with the slides containing the pictures, as in the film. Another arrangement which it would be well to make, but which was not made in this study, is to have the subtitles shown simultaneously with the pictures.

One of the problems frequently raised concerning the presentation of motion pictures is whether the instructor should talk with the film. In order to throw light upon this problem, films have been exhibited with and without the accompaniment of oral discussion.

Other comparisons have been made as follows: A class was shown both the film and a collection of slides made from the film. To another group the film was shown twice. Again the motion picture projected twice was paralleled with a lengthened presentation of slides or with a prolonged oral discussion with or without charts or pictures. In other comparisons pictures or charts were used in place of slides. These pictures were taken directly from the films and were shown with accompanying oral discussion. In still other cases the pictures were placed upon small prints and shown in connection with printed or mimeo-

graphed verbal discussion. This was to compare with the motion picture film material which is organized in the fashion of textbook. In a few cases oral discussion was compared with the film without any accompanying pictures or charts.

For certain types of material, demonstration by the teacher was the form of presentation to be compared with the film or the slide. The study of demonstration as a form of presentation was applied to the teaching of manual arts, and of laboratory science. In teaching position in handwriting, the effectiveness of a motion picture was compared with knowledge on the part of the pupils of their individual scores and with the ordinary mode of instruction.

In all these cases, as has already been said, the modes of presentation which were compared contain materials which are closely similar. In another group of cases the material used in the parallel modes of presentation was not duplicated so closely. In an experiment in the field of health education the division was made in this fashion: One group of pupils was given instruction by a great variety of methods. These methods included pictorial representation by motion pictures and by still pictures, projects, and oral instruction. In the parallel group all of these methods were used except the motion pictures, and for these was substituted oral instruction in the form of reviews.

The foregoing brief survey will serve to illustrate something of the variety of methods of presentation that were studied. It will also indicate that considerable care was taken to avoid the invalidation of the results from differences in the content of the subject-matter rather than in the form in which it was presented.

The comparisons already alluded to deal with entire films. The purpose in general was to determine whether the film as a whole gives better results than some other method of presentation as a whole. It is possible, to be sure, by such a method to analyze to some extent the effectiveness of the methods which are compared by classifying the scores which the pupils make in the different parts of the tests. Such an analysis was also made in a somewhat more definite fashion by breaking the film itself up

and by comparing certain parts of the film with other modes of presenting these individual parts. This was done by cutting out of the film certain parts and presenting them in some other way, while the rest of the film was left intact. For example, a particular film included considerable tabular material in subtitles. This tabular material was shown upon charts or was mimeographed and read individually by the pupils. In the same film there were a number of charts made up of line drawings. These charts again were shown by themselves and the rest of the film was shown in its original form. This type of analytical comparison should undoubtedly be carried much farther in order not merely to determine whether a film is good as a whole, but what parts are good and what parts are poor. It is true, one must avoid disrupting the unity of a film, but in certain cases the experiment can be made without serious difficulty on this score.

Another type of comparison which was represented to a slight extent in the study, consists of a comparison of the effectiveness of a film as a means of introducing a subject, or as a means of summarizing it. There is a very large field of study in problems of this character which are concerned not so much with the value of the film as with the best manner of using the film. The continuation of the study of this type of problem will undoubtedly be very productive in pointing the way to the administrative use of motion pictures in the school.

THE CHARACTER AND SELECTION OF THE FILMS

The types of experiments may further be illustrated by indicating the classes of films which were used. The question has rightly been raised whether the films represented the truly educational motion pictures. So far as it was possible to do so, films were selected which represented the best types of educational motion pictures. In practically all cases they had been made specifically for educational use and were not films which were first intended for use in the theater and then taken over for use in the school. Of the educational films themselves, a considerable

variety of types were employed. They included the subjects of geography, nature study or biology, public hygiene, health education, physics, cooking, history, economics, handwork, and handwriting. Probably the chief omission is the dramatic film. A tentative study is now being made of the effect of dramatic films also, but the bulk of the investigation has dealt with what have been called "text films" or "school films." The study, in other words, has dealt chiefly with films which are designed to give information or to teach how to perform an activity. This is not because of the belief that dramatic films are not educational or do not have a legitimate place in the school, but chiefly because the methods of investigation of the results of such films have scarcely developed to a point which makes an immediately productive study of them possible.

The problem of the selection of the films has already been mentioned. It goes without saying that one could not draw very definite conclusions regarding the value of a particular type of film from an experiment with only one representative of that type. No one would judge the value of textbooks or of the laboratory method from an examination of a single textbook, or a single laboratory exercise. This fact, of course, has been kept very clearly in mind by the authors of the present study.

There are two ways in which this difficulty may be in part overcome. The first is by as careful a selection of films as possible. In general the attempt was made in this study to select definitely superior films. It might have been possible, of course, to select decidedly poor films, and in this way to load the investigation. Another and perhaps a legitimate procedure, would have been to attempt to select average films. In view of the fact, however, that visual education, as represented by motion pictures, is new, it is legitimate to assume that the grade of pictures will rapidly improve, and that therefore those pictures which are at the present time the best may shortly represent the average.

It would, of course, be too much to expect that the selection of pictures should meet with universal agreement. This is

unavoidable. All that the authors of the report claim is that they made an honest effort to select films which would represent the best of their kind.

The second method of overcoming this difficulty is to take refuge in numbers. If an unfortunate selection is made of a particular film, the error will be counterbalanced by other films which are exceptionally good. If a considerable number of films are used, therefore, as was the case in this investigation, it is hardly likely that the results are greatly vitiated by the character of the particular films which were chosen. However, the number of films which have been experimented with is still limited, and it is desirable that many more be subjected to these and other types of experimentation.

SUBJECTS OF THE STUDY

The general method of making the comparison of the effectiveness of different forms of presentation or of different elements in a film was the method of parallel groups. This seems to be the only method which is available, since one could not present the same subject to a group of children first by one mode of presentation and then by another. In this case a second presentation would not be comparable to the first.

Two general forms of parallel grouping were used. The one which was employed in the greater number of cases involved the careful matching of the individuals of limited groups. This matching was done on the basis of such characteristics as age, grade, score in an intelligence test, score in a reading test, and score in a preliminary test in the subject under examination. Not all of the latter three criteria were used in any particular case. The organization of parallel groups in this manner insures that the error which might result from a wide divergence in the abilities of the children is at least reduced to a comparatively small amount.

The second method of organizing parallel groups was to take groups which were so large that individual differences could be assumed to counterbalance each other. This, of course, could not

be assumed unless the groups were similar in such general characteristics as age, race, social environment, and type of education. In all cases they were chosen so as to be similar in these respects. The children who were used as subjects in this investigation were nearly all public-school pupils. Most of them were situated in the intermediate or upper grades, but a few were in the high school. The schools were situated in a number of cities, so that a variety of communities were represented. The cities in which experiments were made include Evanston, Urbana, Detroit, Cleveland, Oak Park, Joliet, and Chicago.

TESTS OF RESULTS

The selection of appropriate tests is of course an important consideration in any such investigation as this. It is particularly important in the case of visual education, since it may be that the results of this method of instruction are of different character from the results of the oral lecture or textbook. It has been thought that the tests which have been devised to measure the results of teaching of the ordinary sort are not well adapted to measure the results of visual education. This has been recognized as a problem in the organization of our experiments. We have attempted so far as possible to use tests which should measure the educational outcome which it was evidently the purpose to secure.

The question has sometimes been raised in regard to these tests whether or not they measured the interest which is awakened in children by viewing motion pictures as compared with the interest they take in other modes of presentation. Various methods of measuring interest directly might be used, but none of them seem highly satisfactory. The questionnaire method is the prevailing one, but this is recognized generally as being not very reliable. It is undoubtedly true, however, that interest can be measured in a fairly satisfactory way indirectly. Even an information test is to some degree a measure of interest, because the pupil will derive more information from a subject in which he is interested or from a lesson which is presented in

an interesting fashion than from one which is dull. The same is true of the acquirement of an act of skill. If the pupil is interested in his task, he will make more rapid gain, and, therefore, attain a higher level of ability than if he is bored.

In certain of the experiments, furthermore, the aim of the teaching was to induce the children to form habits of hygienic living outside of school. The extent to which they performed the activities is undoubtedly a fairly accurate measure of their interest.

It was planned to secure still further evidence on this point by making a comparative measurement of the amount of follow-up reading which children do in connection with subjects which are presented in various ways. The limitations of time, however, prevented the completion of this experiment.

The tests which were used fall in general under the two heads of "information" and of "ability to do." The tests of information were constructed with as much care as possible according to the general procedure of designing standardized tests. Such devices as the completion test, the multiple-answer test, and the right-and-wrong test were employed. In addition to these verbal tests, drawing was used wherever it was appropriate.

The results of the investigation indicate that even the verbal tests are more satisfactory than was anticipated. They seem, on the whole, to have given reasonably adequate measures of the educational effectiveness of the various forms of presentation which were compared. This is shown, first, by the fact that these tests agreed well with the performance tests in certain cases in which both types of tests were used in the same experiment. It is shown, second, by the fact that under the various conditions of the investigation the tests yielded various kinds of results. In some cases the verbal-test scores favored the visual presentation, and in some cases they did not. That is, the tests seem to be sensitive to the variations in the conditions which they are designed to measure. Furthermore, it is possible by analysis of the conditions and the scores in the tests to explain the divergencies in the scores in a fairly successful manner. The authors

of the experiments, therefore, have much greater confidence in the adequacy of the tests which they used than they had at the outset of the investigation.

The tests of ability to do or to make something were used in a number of cases and the experiments were designed to give as much opportunity as possible for the application of this type of test. For example, after being shown how to make a pasteboard box or a reed mat, the children actually made these objects, and their products were scored. After the presentation of a lesson in physics, they engaged in a laboratory exercise and their performance was scored. After being taught by various methods to assume correct positions in handwriting, their positions were scored on an objective scale.

In order that tests of this character might be applied, several films suitable for this kind of an experiment were actually constructed during the course of this investigation. This includes the films showing how to make a reed mat, how to make a pasteboard box, and showing good and poor positions in handwriting.

CHAPTER II

INDIVIDUAL ACCOUNT OF THE EXPERIMENTS AND THEIR RESULTS

1. Experiments at Evanston and Urbana Comparing a Number of Text Films with Various Parallel Modes of Presentation, by F. D. McClusky

The series of experiments begun by McClusky in Evanston and continued in Urbana were chronologically the first of the investigation. They were begun, in fact, before the Commonwealth grant was made, as a Doctor's dissertation, but were incorporated into the general investigation and were completed with the aid of the fund.

At the time these experiments began there was very little accurate information in published reports concerning the general value of text films as means of teaching facts of history, geography, natural science, and similar subjects, in comparison with other visual methods, or with oral lecture and discussion. Weber's¹ study was not yet published at the beginning of the study and when it did appear it was clear that it constituted only the beginning of the attack on this problem. Weber used a limited number of films in the first place, and in the second place the only method of presentation with which he compared the films was a dry and uninteresting form of oral presentation. It seemed worth while, therefore, to pursue this general form of inquiry considerably farther.

McClusky's general procedure was to show a motion picture film to one group of children, to present the same subject-matter to another group by some other method, and then to test the results. In some cases the film was shown twice or was combined

¹ Joseph J. Weber, "Comparative Effectiveness of Some Visual Aids in Seventh Grade Instruction," *Educational Screen*. Chicago, 1922.

with some other mode of presentation. We may examine his procedure in a little greater detail.

The films which McClusky used were in all cases text films, or films designed and manufactured throughout for classroom use. They were all produced by the Society for Visual Education. The first, *French Explorations in North America*, is a historical film. It consists of maps with animated lines showing the location of the various explorations, of reproductions of historical still pictures, of subtitles containing verbal information, and of a very few action scenes. The second film is a picture of the development of the monarch butterfly with subtitles explaining it. The third film gives a description of the Panama Canal and its geographic setting. The fourth gives a historical and descriptive account of canals in the United States. The fifth film is an exposition of two forms of waste disposal in cities, one characteristic of a coast city and the other of an inland city. The methods of disposal are indicated by diagrams, pictures, and explanatory subtitles. The sixth deals with the development and action of mountain glaciers. The development of the glacier is represented chiefly by a motion picture of an instructor (Dr. Atwood) sketching its evolution on the blackboard. The last film deals with the development of steamboats in the history of the United States. A small section only of this film was used, consisting of a picture of moving steamboats. This picture of moving ships was compared with slides of the same ships which were obtained by projecting the still film. In the final comparison the motion picture was not used but a comparison was made between the stereograph and the slide. The subject was the geography of the Middle Atlantic states.

In McClusky's experiments the comparisons were usually between the film, on the one hand, and some other form of visual presentation, on the other hand. In a number of experiments the film was compared with a combination of the film and oral comment, slides, or charts. In other cases the film was compared with slides accompanied by oral comment. In still other cases the film was compared with oral presentation accompanied by

charts or maps. In one case stereographs were compared with slides, each being accompanied by oral comment. In all of the comparisons the time taken in parallel classes was the same.

When the motion picture film was compared with some other mode of presentation the material of the parallel exercises was made as nearly alike as possible in content and in organization. When the lesson was presented by means of charts, for example, the charts were taken directly from the film by projecting the film upon large cardboard sheets and tracing the outline of the picture upon it. So far as possible the difference between the parallel exercises was confined to the fact that one was presented in motion pictures and the other in the form of illustrated lecture.

The results of McClusky's experiments are shown in Figures 1 to 8. The scores of the groups which saw the film are in each case represented by the solid black column. The scores of the groups to which other types of presentation were given are indicated by columns with diagonal lines or cross-hatching. The name of the film which was used in each case is indicated. Next is indicated the name of the city, and the school, then the character of the presentation, and finally the scores which were made by the various groups. Thus in the first experiment the film, *French Explorations*, was used in the University Elementary School, and a comparison was made between the presentation of the film to one group and an oral presentation with map to the second group. The scores of the two groups after the presentation were approximately equal.

The same film was again used in Evanston in the Central School and in the Lincoln School. In the Central School, the scores in the film group were much inferior to those made by the other two groups. The order of excellence was film, film and oral, oral and map, the last giving the best results. In the Lincoln School, however, the three methods of presentation gave substantially the same results.

This film is one which consists largely of animated maps, of subtitles, and of a few reproductions of photographs in which there is no motion. It appears, therefore, that a film of this sort

is at least not superior, and possibly slightly inferior, to oral lecture accompanied by map. The results do not indicate unequivocally whether the use of the verbal introduction, which is prepared by the producers and is sent out with the film, increases its effectiveness or not.

The next group of experiments was made with a film on the Panama Canal (Fig. 2). This film contains largely subtitles

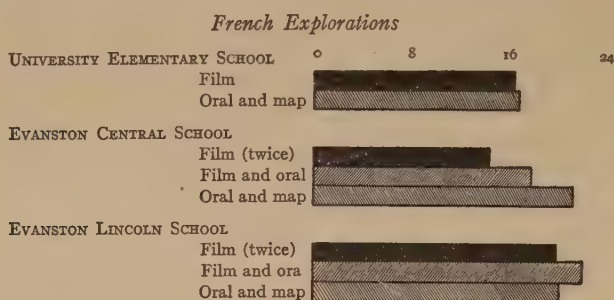


FIG. 1.—Comparison of film, film and oral-lecture, and oral-lecture with map

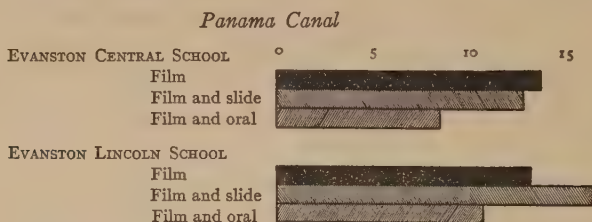


FIG. 2.—Comparison of film with a combination of film and slide and a combination of film and oral-lecture.

and still pictures together with animated cartoons and maps. Three-quarters of the footage is made up of the subtitles and still pictures and 20 per cent of cartoons and maps. Only 5 per cent contains action pictures. In these experiments the comparison is between the film shown twice and the film supplemented by an oral lecture with slides in one case and by the reading of the printed essay which is sent out by the Society for Visual Education to accompany the film in the other case. Taking the two groups together, the group which saw the film and also the slides

makes a superior record as compared with the pure film group. The groups which saw the film with the accompaniment of the verbal introduction which came with the film made a much poorer score than did the other two groups.

Three experiments were made with the film entitled *The Story of a Mountain Glacier* (Fig. 3). This is a film of very

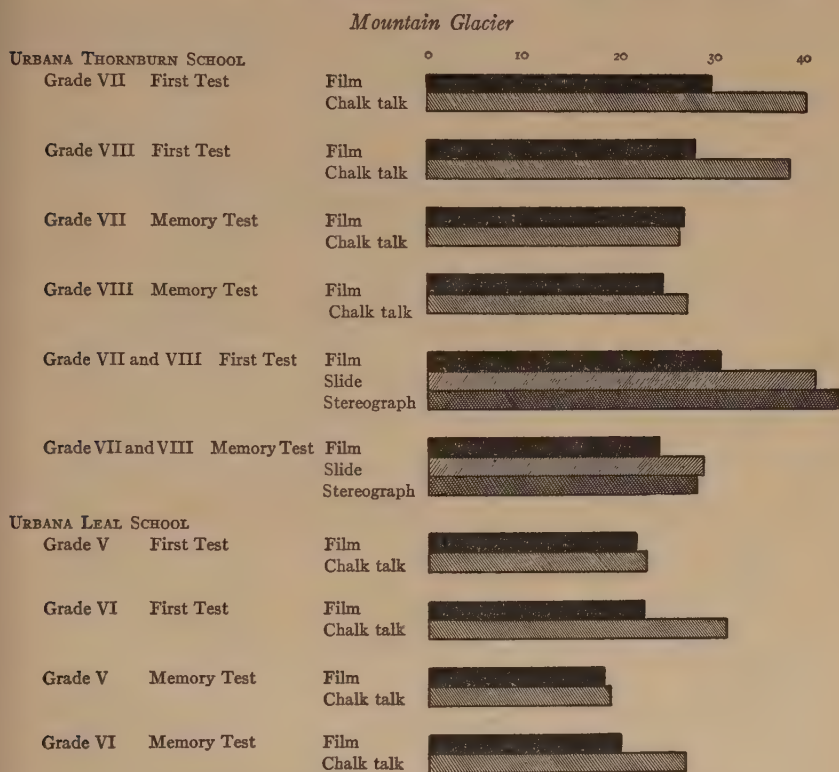


FIG. 3.—Comparison of film with chalk talk and with slide and stereograph

unusual character. It consists of a motion picture of an instructor, Dr. Atwood, drawing on the blackboard the successive stages of the development of the glacier. The film attempts, therefore, to reproduce an illustrated lecture. Seventy-seven per cent of the footage is of this character; a very small percentage is in separate subtitles, namely 10 per cent; 10 per cent consists of

still pictures and less than 3 per cent of action pictures. In the first of the three parts of this experiment the film was shown to one group, and to a parallel group the experimenter attempted to duplicate the film as nearly as possible by a blackboard lecture. In the third part of the experiment the same procedure was carried out with the difference that the blackboard lecture was given by the classroom teacher. In the second part of the experiment the film was compared with a lecture supplemented by slides and with a lecture supplemented by stereographs.

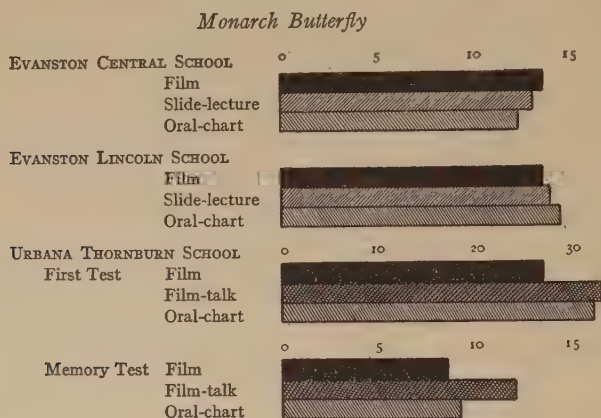


FIG. 4.—Comparison of the film with the slide-lecture and with the oral-chart methods.

In all but one of the groups in which the chalk talk by the teacher was compared with the film, the parallel group made a better showing. In two of the classes the superiority was marked. In the remaining classes the scores were nearly equal. The slide lecture and the stereograph lecture also produced superior results, in one class to a very marked degree. The results as a whole, then, indicate that this type of motion picture is inferior to the presentation of the same subject-matter by a teacher either with the aid of a blackboard or of slides and stereographs.

In two other experiments the film which was used was *The Life History of the Monarch Butterfly* (Fig. 4). This film is a picture of the development of the butterfly through its various

stages. It contains the largest proportion of action of any of the films which were used in this section of the investigation, namely 59 per cent. Something less than one-quarter of the film was taken up with subtitles and less than 20 per cent with still pictures. The presentations which were compared with the film were a lecture accompanied by slides, a lecture accompanied

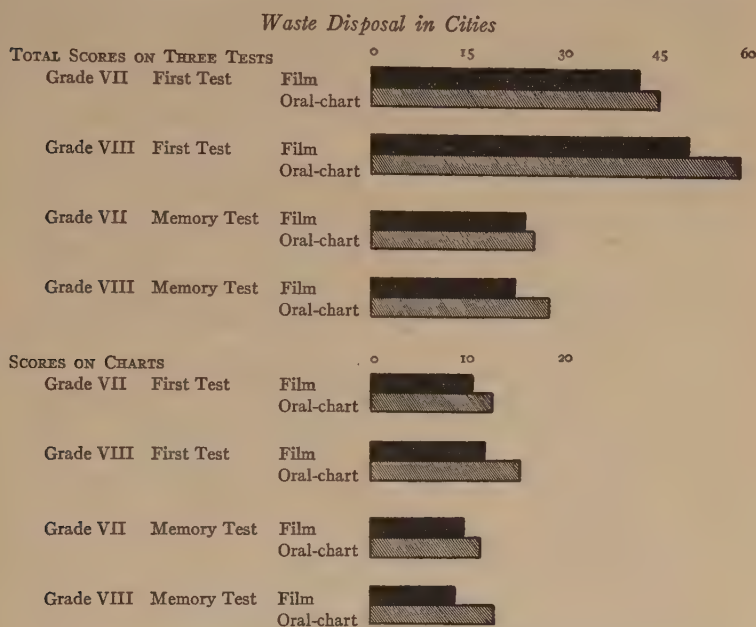


FIG. 5.—Comparison of film with the combination of oral-lecture and chart

by charts or drawings on the board, and the film accompanied by simultaneous oral comment.

Taking the results as a whole, the scores made by the film groups are about the same as those made by the groups which had the slide lecture, or the oral-chart presentation. The group to whom the film was shown accompanied by oral discussion during the showing of the film made a considerably higher score than the group to whom the film was shown alone.

In the experiment with the film, *Waste Disposal in Cities*, the film was compared with an oral lecture accompanied by

reference to a number of charts which were drawn directly from the projection of the film itself (Fig. 5). The film explains two methods of waste disposal, one in a coast city and the other in an inland city. In both the immediate test and the memory test, the lecture group excelled the moving-picture group. Part of the test consisted of drawing a diagram to illustrate the processes which were being explained. The scores on this test, as shown in the detailed report, indicate that the superiority of the non-film group is due more largely to the scores in this diagram test than to the verbal test. This indicates that the

Canals in United States History

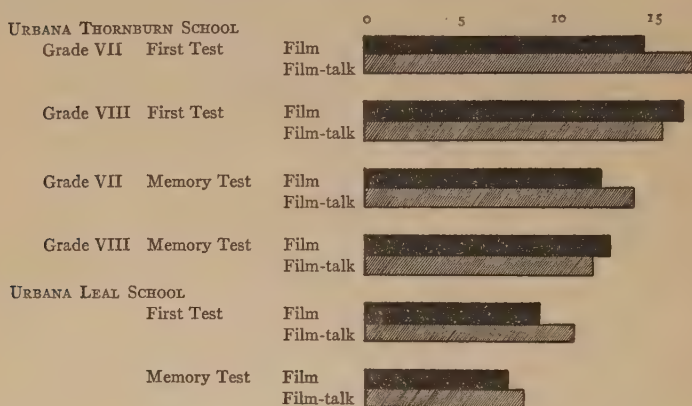


FIG. 6.—Comparison of film alone with film accompanied by oral comment

superiority of the oral-chart group was due, not to verbal facility, but to a real understanding of the subject.

The film which was used in the next experiment, *Canals in United States History*, is another one in which animated cartoons and maps are used largely. The percentage of this type of material in this film is 46. In addition to this, 37 per cent consists of subtitles. This film, therefore, is only to a slight extent a picture of action, since but $5\frac{1}{2}$ per cent of the entire film consists of pictures of moving objects. The balance of evidence as presented in Figure 6, appears to indicate that in this type of

film the addition of oral comment during the showing of the film adds to its effectiveness.

An experiment was made to measure the relative effectiveness of stereographs, used during the study of a geography lesson, and slides, used to summarize a lesson after it had been studied. The results, shown in Figure 7, indicate that the stereographs were somewhat more effective as indicated by the map test. The difference in the verbal test was so slight as to be uncertain.

Another experiment was for the purpose of determining whether an actual action picture produced a result which is superior to a still picture of the same subject. The action picture was taken from a film entitled *The Steamboat in United States History* and was a picture of a moving boat. This was compared

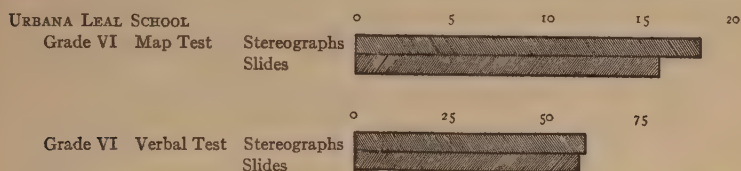


FIG. 7.—Comparison of stereographs and slides in teaching the geography of the Middle Atlantic states.

with a slide of the same object. It will be seen from Figure 8 that both in the original test and in the memory test the group which saw the film made a considerably better showing.

We shall consider these results again topically in connection with the results of the other experiments which are similar to them.

There is a current opinion that visual presentation produces a more lasting impression than do other forms of presentation. The relative permanence of what is learned is a pertinent consideration in the comparison of both visual and non-visual methods and of various types of visual presentation. Accordingly memory tests were given in a number of the experiments several weeks after the first test. These included the experiments with the films, *The Story of the Mountain Glacier*, *The Monarch Butterfly*, *Waste Disposal in Cities*, *Canals in United States History*, and *The Steamboat in United States History*.

The first fact which is borne out by the memory tests is that, with one exception, when the difference in the scores of parallel groups in the first test is at all marked the differences are in the same direction in the memory tests. The group which is superior in the first test is superior in the second. This indicates that the average scores of the groups are reliable measures and that the differences between the groups are real differences.

The second observation is that the differences between the parallel groups are usually somewhat less in the memory test than in the first test, due to the fact that the group making the higher score on the first test loses somewhat more than the group

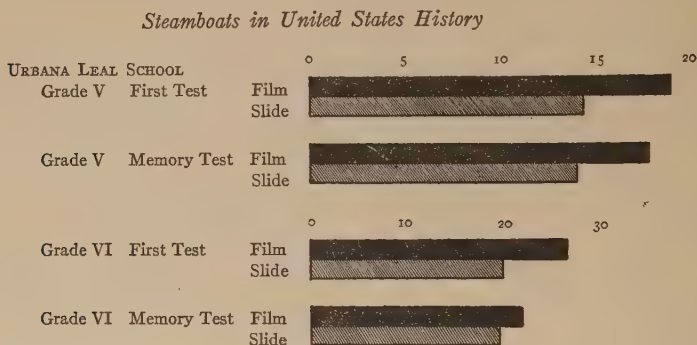


FIG. 8.—Comparison of film with slide

making the lower score. The relationship is shown most clearly in the experiments in which the differences between groups are most marked, namely those on the mountain glacier, waste disposal, and steamboats. If we had only the results of the first two experiments we might conclude that the motion picture shows less loss because the impressions made by that form of presentation are inherently more permanent than those which are made by the lecture and chart method. If this were the case, however, we could not explain the greater loss in the case of the motion picture groups in the experiment with the film on steamboats. The rule appears to be that the method which produces the higher initial score suffers the greater loss. This

may be due to the fact that those items of information in which the superior group excels are the ones most difficult to grasp or those of least fundamental importance and that they are the most readily forgotten. This, however, is only a hypothesis.

2. A Comparison of the Teaching Value of Films and Oral Instruction in Two Short Projects and of a Combination of Visual and Oral Instruction with Oral Instruction Alone in a Long Project, by E. H. Reeder and Frank N. Freeman

The two short projects in this experiment consisted of lessons based on geography, one entitled *Reclaiming Arid Lands by Irrigation* and the other *Orange Culture*. In each case the film

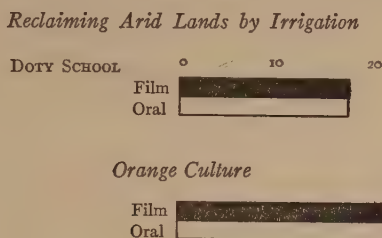


FIG. 9.—Comparison of the effectiveness of two motion picture films with oral instruction.

was shown to one group and an oral lesson, organized to contain the same subject-matter as the film, was taught to a parallel group. The two comparisons were made in the Doty School, Detroit.

The results of these comparisons, as tested by multiple-answer and completion tests are shown graphically in Figure 9. It appears that the oral groups gained as much information as did the groups which viewed the films. This is in harmony with the results of some of the other experiments and out of harmony with others. We shall have to defer the comparison of the various experiments until all are before us.

The long project dealt with the geography of Egypt and was carried through a period of four weeks. The experiment was

made in two schools, the Lingemann and Columbian Schools, Detroit. One group in each school was taught with the aid of motion pictures, stereopticon slides, stereographs, and models. The parallel group was taught solely by oral instruction. The subject-matter which was covered in the two schools was substantially the same and tests of similar construction were used. The work was under the charge of a different teacher in the two schools, however, and the instruction and the tests differed somewhat in detail.

Geography of Egypt

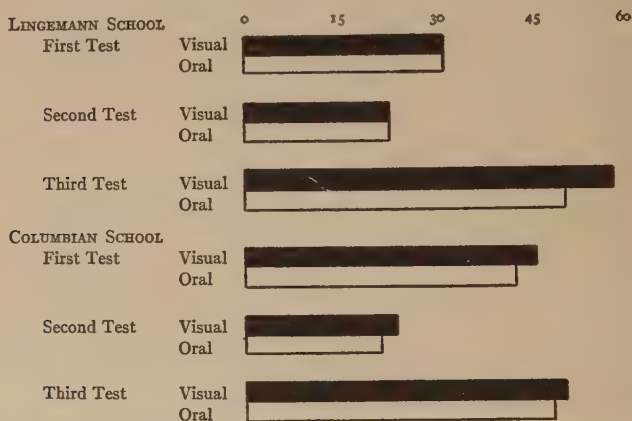


FIG. 10.—Comparison of the effectiveness of instruction which includes visual aids with oral instruction in teaching a four weeks' unit in geography.

The results of the comparisons are presented in Figure 10. In the Lingemann School, the first two tests indicate no difference in the effectiveness of oral instruction and the combination of oral and visual instruction. The third test, which is a composition test, however, favors the visual group. In the Columbian School all three tests are favorable to the visual aids. As a whole the evidence is that the various visual materials increase the effectiveness of instruction in geography. The difference is not as great as we should perhaps expect it to be, and the visual instruction does not invariably give superior results. This suggests that some types of visual material may

not be particularly helpful, or that pupils may in some cases already possess the necessary experience to enable them to interpret oral instruction without the presentation of further concrete materials. The results of the experiment appear to indicate, however, that in the case of the larger project, the pupils did lack some of the concrete experience which was essential to a full comprehension of the instruction and that this experience was in a measure supplied by the various types of visual material which were employed.

3. Comparison of Educational Motion Picture Films with Oral Lecture, Textbook Study, and Slides in the Case of Six Films, by H. W. James

The main problem of these experiments was to determine the general effectiveness of motion picture films and several other modes of presenting the same material. The film was compared with the oral lecture in six cases, each film being used for this type of comparison. In addition the film was compared with printed material in one case, and in two cases the film was compared with slides. In one of these slide tests the projection was made by cutting out one frame of each picture and each subtitle and cementing these frames together. These frames were presented one at a time for the same length of time as was occupied by the corresponding scenes and subtitles from which they were taken.

In two cases the effectiveness of the parallel forms of presentation was measured by giving the classes follow-up reading matter on the same subject and then testing them on their comprehension of this reading matter on the assumption that a more effective original presentation would produce greater interest in the subsequent reading. This test was additional to the usual verbal test. In some cases a test was given before as well as after teaching.

In two cases a test was made of the effectiveness of accompaniments to the films. Once this consisted of oral lecture and once of music.

Three of the films were from the Society for Visual Education, viz., *Toads*, *Waste Disposal in Cities*, and *The Mosquito*. Two, *Yellowstone Park* and *Lumbering in the North Woods*, were from the Ford Studio, and one, *Through Life's Window*, a film on the eye, from the Worcester Film Corporation.

In a preliminary experiment with three films in the University Elementary School at Iowa City, James compared the gains made by the children after having seen the film and after oral presentation of the same subject-matter. In the case of one of the films, the gain made by the groups which had the oral presentation was greater than that made by the group which saw the film. In the case of the two other films, the gains made by the film groups were the greatest. This preliminary experiment was not so carefully controlled as the later one and the results will not be given here in detail.

The three chief comparisons which were made by James in his Detroit experiment were made between the film and an oral lecture, the film and reading, and the film and still pictures with subtitles. We may consider these three chief comparisons first.

Before proceeding to the results of this experiment comment should be made upon the nature of the three presentations which were compared with the film. The oral lecture and the reading materials may be considered together since they were organized in a similar fashion. James describes the method by which the oral lecture, which is to be compared with the film, was made up as follows:

An outline was either made or secured of all the titles and subtitles of the film. This was gone over with the teachers and then the film was run and re-run for the teachers with this in their hands and notes built up around these titles. In the oral presentation these subtitles were used verbatim and emphasized to correspond to the emphasis given in the film. The goal idea in these oral lessons was to make a lesson as nearly identical in material presented as possible. In the judgment of the writer the above method seems to allow less deviation between the two presentations than any other.

It is evident from this description that the primary aim in the mind of the experimenter was to secure identity in form and

in content between the motion picture film and the oral lecture. This identity was secured by copying and reproducing orally the titles and subtitles and then supplementing these by a few additional sentences. The film, in other words, formed the basis of the organization of the lectures. This procedure differed from that which is followed by McClusky in his experiment. McClusky endeavored, to be sure, to cover the same topics and include the same facts in the oral presentation, or the oral presentation accompanied by charts, as was included in the film, but he did not attempt to follow in this detailed manner the form of presentation in the film.

How this method works out in detail may be seen from the comparison of the film with the reading material which was used in the experiment in which reading was compared with the film. We may present a few of the subtitles which appeared in the film in parallel to the reading material which was used by the parallel classes.

SUBTITLES AND DESCRIPTIONS OF THE FILM

Waste comes from the house

A picture of a typical house

From the sink, washbowl, water-closet, bathtub, refrigerator, and washtub

An architect's drawing of a house in cross-section showing how the plumbing is installed

It flows to the street sewer

A picture of three buildings taken from above followed by a diagram showing how the house sewers enter the street sewer

PARALLEL READING MATERIAL

Waste comes from the house

The present-day conditions with modern water systems—each family has a large amount of sewerage to dispose of daily

From the sink, washbowl, water-closet, bathtub, refrigerator, and washtub

The drains from these various conveniences are brought into one central pipe in the house. A chart of this system would look something like the branches of a tree running down the trunk

It flows to the street sewer

This main sewer pipe from the house enters the street sewer into which all the house sewers on the street pour their content

SUBTITLES AND DESCRIPTIONS OF THE FILM	PARALLEL READING MATERIAL
<i>From the street sewers to collecting sewer</i>	<i>From the street sewers to collecting sewer</i>
A picture of a section of the Boston shore front followed by a diagram showing the street sewers running into the intercepting sewers	The street sewers enter the collecting sewers similar to the house sewers entering the street sewers

The film was made up of the following types of material: subtitles 25 per cent (these subtitles, it will be remembered, are reproduced in the reading material), still pictures 27 per cent, action pictures 23 per cent, animated cartoons and maps 13 per cent, still cartoons and maps 10 per cent. The cartoons and maps make up then about 25 per cent, the action pictures a little less than 25 per cent, still pictures 25 per cent, and the subtitles 25 per cent. For the pictures and the cartoons are substituted the reading material which has been illustrated above. In the reading material the part which duplicates the subtitles consists of 241 words. The rest of the material which is substituted for the pictures takes up 600 words. If this occupied the same relative proportion to the subtitles as in the film it would occupy 723 words. The additional descriptive material, therefore, is 123 words short of what it might be to fill out the correct proportion. The entire reading material consists of 841 words which was read in fourteen minutes. This makes 60 words a minute or one word a second. The reading material, therefore, is to be read by the children at a somewhat slower rate than the subtitles are read in the moving-pictures. Children could read at a rate about three times as fast as this. These facts must be taken into consideration in comparing the results in James's experiment with the results in McClusky's experiment since we shall find that they seem on the surface to be contradictory.

The result of James's Detroit experiment are summarized graphically in Figures 11, 12, and 13. We may first examine the comparative results of the presentation by the film and the oral

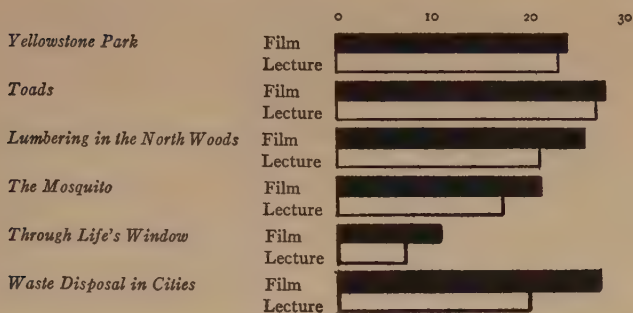


FIG. 11.—Effectiveness of various types of films compared with oral presentation.

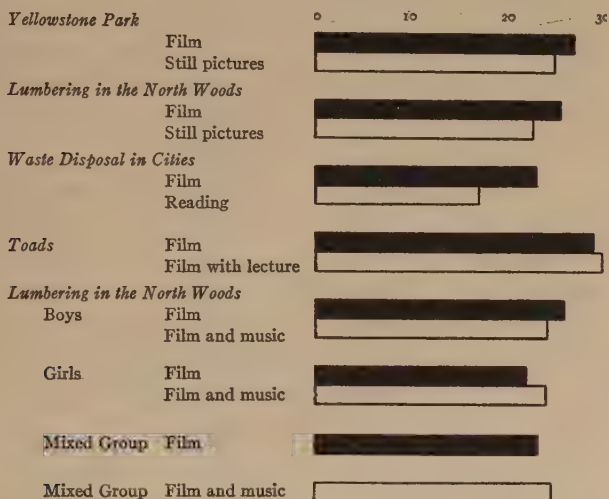


FIG. 12.—Comparison of film with various other forms of presentation

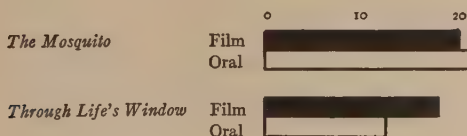


FIG. 13.—Comparison of the reading of the same passages by groups who had been introduced to the subject by oral-lecture, on the one hand, or by a motion picture film, on the other. The bars represent scores in the reading test.

presentation. We find such comparison in the case of the following films: *Yellowstone Park*, *Toads*, *Lumbering in the North Woods*, *The Mosquito*, *Through Life's Window*, and *Waste Disposal in Cities*. In other words this comparison was made with each film.

In each case the film presentation gives better results than oral presentation. In the film on toads the result of the two forms of presentation is practically equal. It appears thoroughly established, therefore, that the film which is of the type represented in these experiments, namely the text or informational film, gives superior results to the type of oral presentation which was used in these experiments. This result agrees with the findings of Weber and agrees with James's earlier preliminary experiment except in the case of one of the films.

In interpreting this result we must remember the character of the oral presentation. It corresponds with the character of the reading material which was compared with the film and which has been described above. In other words the oral presentation here consists of a point by point following of the section of the film in an attempt to reproduce in detail in speech the subtitles and the pictures which are presented in the film.

Two problems are presented by these results. The first is, What type of experience can suitably be given by means of oral speech? And second, How can this experience be best set up, or what types of oral presentation are best adapted to producing these experiences? In general in answer to the first question we may undoubtedly say with assurance that the adequacy of oral presentation depends upon the previous concrete experiences of the child. Words cannot be substituted for contact with things, but words may serve to revive previous experiences with things. In each particular case it is necessary to determine whether the child has had the previous concrete experiences necessary to enable him to interpret the words.

In answer to the second question we may venture the opinion that the organization of an oral lecture probably should proceed after a somewhat different manner than the organization of a

motion picture film. At any rate the final determination of whether motion pictures or an oral lecture is best in a particular case will depend in part on the way in which both the motion picture film and the oral lecture are organized.

A comparison of the motion picture film with reading was made in the case of the one film, *Waste Disposal in Cities*. The character of the reading material has already been described. The result here indicates a very marked superiority of the film. This is hardly surprising in view of the character of the film and in view of the way in which the reading material was organized. However, in spite of the possible inadequacy of the reading material, we should hardly expect a film which is so largely descriptive to be successfully duplicated by pure reading material without pictures.

In the case of two films the motion picture film was compared with a series of still pictures which were made by taking sections of the film and projecting them in stereopticon fashion. With the still pictures were also duplicated the subtitles of the film. The two films which were treated in this way were *Yellowstone Park* and *Lumbering in the North Woods*. In the case of the first film the one test came out to the advantage of the film and the other slightly to the advantage of the still picture. In the case of the second film the still pictures gave somewhat poorer results in the case of both tests. In the case of both films, the composite scores, which are represented in the figure, are favorable to the film. The difference, however, is not marked in any of the cases but we may say that as a whole the film gave somewhat better results than the corresponding still pictures.

In interpreting these results we must take account of the fact that the peculiar advantage of still pictures was not realized in these experiments. The still pictures have the advantage of permitting analysis and discussion while they are being shown. The motion picture is more difficult to analyze in this fashion, although, as we shall see in the account of other experiments, such analysis can be made. In this case, then, the pupils were simply allowed to look at the still pictures without there being

any discussion or analysis of them. If such discussion or analysis had been carried on, the results may have not been to the disadvantage of this method. This conclusion is supported by the results of McClusky's experiment in which discussion was carried on during the stereopticon presentation. James's experiment, then, may be said to indicate that the addition of motion add to the effectiveness of the presentation.

In the case of two of the films—*Toads* and *Lumbering in the North Woods*—the film presentation was compared with film plus something additional. In the first case the additional factor was accompanying lecture, in the second case music. The accompanying lecture apparently neither added to, nor subtracted from, the effect of the film. The music slightly added to the film's effectiveness, but the difference is not great.

It is sometimes held that educational films are of chief importance in the stimulus which they give to interest or in the impetus which they give to further learning on the subject of the film rather than in the information which the film itself gives. In order to gather evidence upon this hypothesis, the experiment in the case of two of the films was organized in the following way. After the film had been presented the reading material on the same subject was given to the classes. They were then tested upon this additional reading material. The assumption was that if the film had aroused keen interest in the subject the pupils who had seen it would do better reading, or would secure a better score on their subsequent reading, than pupils who had been introduced to the reading by means of oral discussion. The two films in which this procedure was followed were *The Mosquito* and *Through Life's Window*. In both cases the follow-up reading was taken from school texts.

It will be seen that in the case of the mosquito film, although the pupils who saw the film scored higher in their first test than the pupils who received oral instruction, the pupils who received oral instruction got more from their subsequent reading than did the two groups which saw the film. In the case of the other film, however, *Through Life's Window*, the pupils who received oral

instruction obtained lower scores upon their subsequent reading than they did in the original test. The difference in the scores upon the follow-up reading, however, was less than the difference in the scores upon the first presentation. While the results of this comparison are not very conclusive either way, they seem to indicate that the indirect effectiveness of the motion picture film is at least no greater than the direct effectiveness as measured by the tests of information which the pupil receives from it, and is in some cases not so great.

4. Comparison of Three Modes of Presentation of the Material Contained in a Film on the Iron and Steel Industry and One on the Lumbering Industry, by F. D. and H. Y. McClusky

In this experiment the general comparative method used in McClusky's earlier experiments was used. The aim of the experiment was to extend the comparison to additional films and to make a comparison of three different methods with the same material. The films used were the Ford Educational Films on iron and steel and on lumbering. In the case of each of these films the material contained in them was also prepared in the form of slides, and a mimeographed text illustrated by photographic prints.

In preparing the materials for the presentation by slides and photographic prints, which were to be compared with the films, reproductions were made in each case from selected frames of the films. The same negatives were used for slides and photographic prints. In the case of the slide presentation, the subtitles which appeared on the films were shown on slides which alternated with those containing the pictures. In the case of the mimeographed text presentation, the subtitles were arranged in sequence so as to make a connected discussion. With the text the child was given a group of photographs. Each photograph was referred to in its order. In this experiment then we have a comparison between the motion picture, slides, and textbook all with the same material.

In this experiment with the films on lumber and on iron and steel, the film, slide, and printed text were each used with and without accompanying oral discussion in order to determine whether study accompanied by such discussion is superior to independent study.

The tests which were used to measure the results of the three modes of comparison used in this experiment were designed especially to surmount the limitations which may possibly attach to verbal tests as measures of the effectiveness of concrete experience. In addition to the usual verbal tests three others were used, a diagramming test, an identification test, and a sorting test. In the diagramming test the pupils were asked to indicate by diagrams the relations in space or time of the processes about which they had learned. In the identification test they were asked to identify various stages of the process as revealed in a series of photographs of similar (but not identical) material, and in the sorting test they indicated the proper sequence of a series of pictures which were taken from the material of the lesson and arranged out of their true order.

The summary results, based on the sum of the scores of the various tests—verbal, diagram, picture-identification and picture-sorting tests—are shown in Figures 14 and 15.

We may first examine the relative effects of each of the various types of presentation—film, slide, and printed text—with and without the accompaniment of oral comment. The advantage of oral comment is unmistakable, since it appears in each one of the individual comparisons. This agrees with the results of the other experiments in which this comparison was made and establishes the fact that, contrary to the prevailing view, suitable and carefully prepared oral comment adds to the effectiveness of film, slide, or even printed text. This is one of the most consistent findings in the entire investigation.

The other comparison is between the film, slide, and text. In each case, of course, we must compare only groups which saw the same film and belong in the same city, and also are alike in respect to the presence or absence of oral comment.

The film may be compared with the slide in four cases. In one case both film and slide were shown with oral comment and in the other three cases without it. In two cases the slide is superior to the film, in one case the film is markedly superior, and in one case film and slide are equal. There is not sufficient advantage on the side either of the film or the slide to indicate that either is superior to the other.

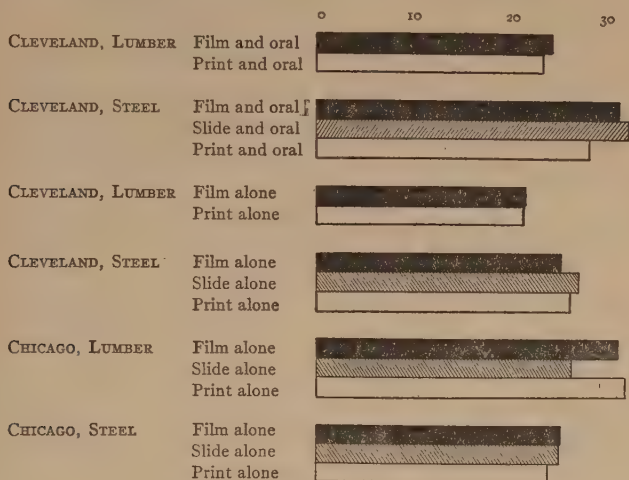


FIG. 14.—Comparison of the film, slide, and illustrated text

We may compare the film and the illustrated text. This comparison may be made in six cases. In three cases the film is superior, in two cases the text is superior, and in one case the scores of the two are substantially alike. The advantage is slightly on the side of the film, but it can be hardly considered great enough to outweigh the advantage of the illustrated text on the score of cheapness and convenience.

There are four cases in which the slide and printed text may be compared. In one case the slide is well ahead. In one case the printed text is still more decidedly ahead. In the other two cases there is slight difference between the two forms of presentation.

The uniformity of the difference in favor of the oral accompaniment indicates its reliability and the lack of uniformity in the difference between the three kinds of visual presentation

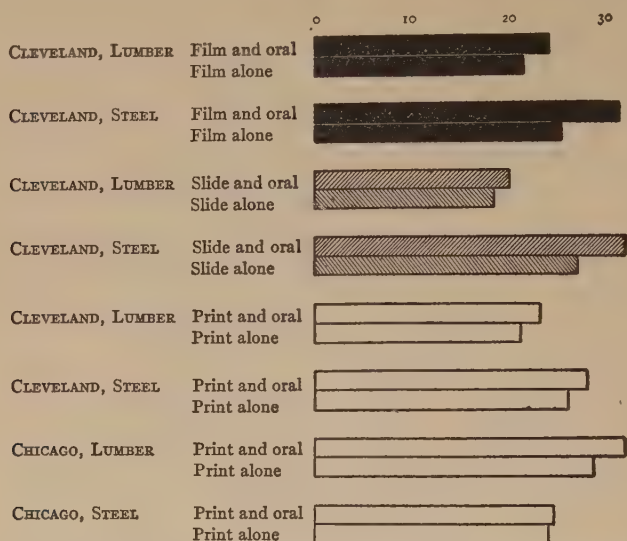


FIG. 15.—Study of the effectiveness of oral comment when it accompanies the film, slide, and illustrated text.

indicates that there is not a clear difference between film and slide, film and text, or text and slide. These methods, as used in this experiment, may be regarded as substantially equal in effectiveness.

5. An Experiment to Study the Effectiveness of a Motion Picture Film which Consists Largely of Tables, Maps, and Charts, as a Means of Teaching Facts or Giving Abstract Information, by Frank N. Freeman, Edwin H. Reeder, and Jean A. Thomas

Is it the function of educational films to present organized lessons which include, beside the pictures of objects and activities, an explanation of the pictures, a discussion of their meaning and significance, and additional information related to the pictures

but not necessary to the understanding of them? Some educational films do this. Another conception of educational motion pictures is that they should present the raw material of lessons which have to do with objects in motion and activities and that the elaboration of the experience of viewing such objects should be left to discussion or reading. Light can be thrown upon this issue by studying the effectiveness of subtitles. Our ordinary tests are not subject to the same criticism when they are used in such a study of subtitles as when they are used to study pictures themselves.

For this experiment a film was selected which contains a large proportion of subtitle material and which presents a great deal of information in its subtitles which is not intimately related to the pictures themselves. The film which was used is the one entitled *Railroads in the United States*, produced by the Society for Visual Education. The film deals with the development of railroads, the changes in mileage, cost, equipment, and expenditures, and the value of the railroads to society. There are twenty-eight subtitles, including tables, diagrams, and maps, in the picture. They occupy a total of 385 feet of film. Many of these subtitles consist of brief statements introducing the pictures, but a large amount of footage is occupied with other types of material. For example, there are eight tables. Besides these tables there are fourteen maps. In some cases the maps are animated—in other cases not. There are also a number of diagrams. The footage devoted to motion pictures proper is only 482 feet. This includes all the maps in which there is any degree of animation.

The experiment was organized by comparing the results of showing the entire film intact with the results of other showings in which one or more of the various types of subtitle material was presented in the form of lecture or printed text accompanied by tables, charts, and maps. The tables, charts, and maps were on sheets of paper which were placed in the hands of the individual pupils or on large sheets of cardboard which were placed in view of the entire class. In the case of one group of

pupils all the material except the pictures themselves was mimeographed and the class studied this mimeographed material for fifteen minutes—the duration of the film. In each of the other groups which used the modified material, part of the subject-matter only was extracted from the film and shown by the substitute method.

The summary of the relative effectiveness of the film and of the other modes of presentation is presented graphically in Figure 16.

In the Condon School the effectiveness of the film was compared with a lecture, supplemented by tables, maps, and charts reproduced from the film, and with a reading text in which the subject-matter of the film was prepared in the form of a mimeographed text, supplemented by the same maps and charts as were used in the lecture. The duration of the lecture and study periods was the same as that of the film lesson. In this experiment the film appears to be slightly less effective than the lecture and slightly more effective than the study of the text.

In the Angell and Miller schools the film was compared with composite forms of presentation in which part of the subject-matter was presented by means of the film and part by means of the lecture. Thus in the comparisons designated by the letter *A*, all the material except the maps was presented in the original form in the film but the maps were shown to the class and described by the teacher—using, of course, the same length of time as was occupied by the maps in the film. In the *B* comparisons the maps and the charts were shown by the teacher, and in the *C* comparisons the maps, charts, and tables were shown by the teacher.

In both schools and in all the tests the returns are consistent in one respect. As more of the material is abstracted from the film and presented by the teacher the mixed mode of presentation gains in comparison with the straight film. This rule is so uniform that it cannot be due to chance, but must represent a real superiority of the lecture method for this type of material. In the Angell School, and in one of the three tests at the Miller School, the mixed group which saw all the film but the maps

did more poorly than did the groups which saw the entire film. In two of the tests at Miller, however, even this mixed group excelled the film group. The mixed groups were undoubtedly at something of a disadvantage, since their attention was shifted back and forth from film to lecture. It would probably, there-

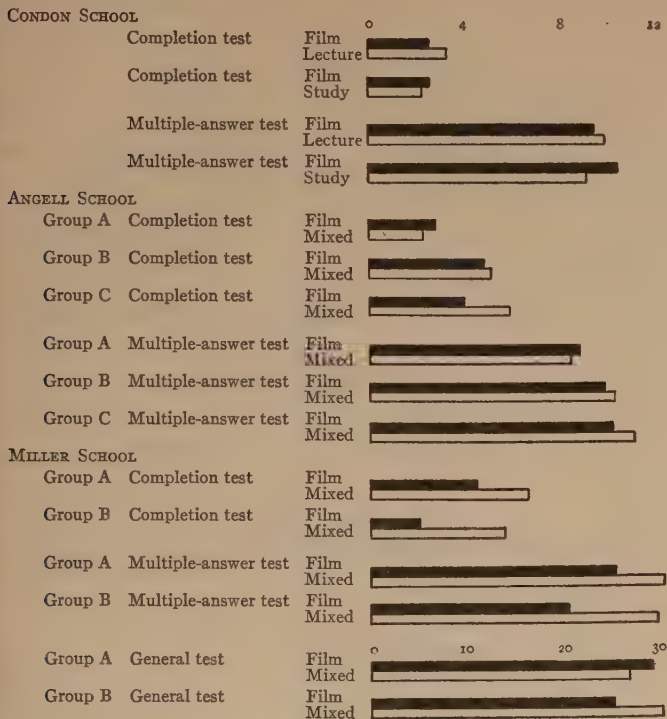


FIG. 16.—Comparison of the effectiveness of the railroad film with lecture or study.

fore, be just to say that the scores of the *A* groups, even, indicate that the presentation of maps by the lecture method is superior to their presentation in a film. However this may be, it is quite clear that the results as a whole indicate that general and somewhat abstract information such as is suitably presented by means of maps, charts, and tables can be taught more effectively by means of the lecture than by means of the motion picture.

6. Study of the Effectiveness of a Motion Picture Film Used as an Introduction to a Topic or as a Summary of a Topic, by A. P. Hollis

In this experiment a comparison was made between the effectiveness of a film as introduction to a subject and the effectiveness of an oral introduction. It was conducted in the following manner: The film entitled *Milk as Food* was shown to a group of pupils. Following this, the next day, a period was occupied in the study of adulterated food following a text. To the parallel group the lesson on the first day consisted of an oral discussion of the topic of "Milk as Food" duplicating the film. On the second day the instruction was the same as that of

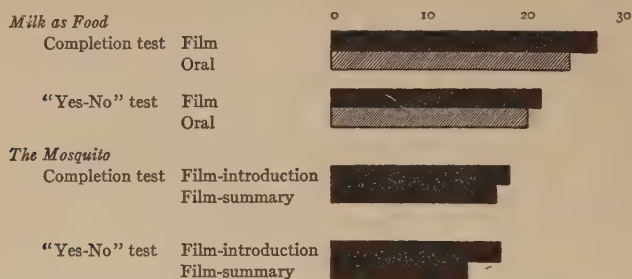


FIG. 17.—Comparison of effectiveness of the film with oral instruction as an introduction to a lesson and of the film as introduction and summary.

the first group. This comparison was made in the case of four groups—two in Detroit and two in Oak Park, Illinois. The scores are combined and the averages shown graphically in Figure 17. In the case of three of the groups the film groups made superior scores upon tests of the subsequent instruction. In the fourth group, however, the pupils who received the oral introduction made the higher score upon the subsequent exercise. While the results are not very conclusive, they seem to indicate a superiority of the film as an introduction to subsequent related instruction, as compared with an oral introduction.

In another series of experiments, a comparison was made between the effectiveness of the film used as an introduction to

a subject and as a summary of the subject. The film which was used was upon mosquitoes. The rest of the instruction was based upon a text on the same subject. The instruction throughout the entire two lessons was kept as similar as possible for the parallel groups.

This experiment was also carried out with four groups of children, one in Detroit and three in Oak Park. In each of the four groups, the classes in which the film was shown as a summary gave inferior scores to those in which the film was used as an introduction. One explanation which is suggested for the superiority of the film used as an introduction is that when used in this way the film creates an interest in the topic which arouses questions in the minds of the pupils and stimulates closer attention to the subsequent material. Another explanation is that when used as an introduction the film presents to the children the concrete material which furnishes the foundation for their later oral discussion and promotes understanding of the lesson. In the light of the results of other experiments of the investigation, it seems likely that the second explanation is the more correct.

7. An Experiment with a Motion Picture Film as a Means of Teaching Position in Handwriting, by Frank N. Freeman, Lena A. Shaw, and D. E. Walker

This experiment was undertaken because an attempt to determine by preliminary analysis what kinds of instruction are probably best adapted to presentation by motion pictures led to the conclusion that one of the chief of these is instruction in doing or making something. Very few films are at present available which give this type of instruction. There are a number of industrial films illustrating machine-shop practice and certain films in the field of athletics and physical culture. But these are not suitable for use in the ordinary school—particularly the elementary school. Since the writer had been engaged for a number of years in experimental studies in the teaching of handwriting and had used the motion picture camera in these studies, it was natural that he should turn to handwriting as a subject in

which to study the value of the motion picture as a means of instruction.

The aspect of the handwriting activity which was selected for this study was position. A motion picture film was constructed which gives illustrations of good and poor positions and in some cases shows the transition from one to the other. The features of position which are shown in the film are position of the head, of the body, of the arms and hand, and the manner of holding the pen.

The pictures which show position of the head, body, and arms were posed. For example, a child was photographed with her head upright and this section was preceded by a subtitle which read "Head Erect, Good Position." In the next section the child is seen to lower her head and turn it to the side. This is preceded by the subtitle, "Head Turned and Bent, Bad Position."

To obtain pictures of good and poor positions of the hand and good and poor examples of penholding, children were selected whose habitual modes of writing illustrated the types sought. These modes cannot be adopted or abandoned at will.

After the film had been made up, its effectiveness as a teaching device was tried out by the method of parallel groups. Two or more groups of children were first scored for position by means of a specially constructed score card. The items of this score card corresponded throughout with the features which made up the film. One group was then taught by the use of the film and another group or groups by other methods. A second application of the score card revealed the relative gain made by the film group and the other groups.

Two experiments were carried out in this manner, a study with two small groups of children in Evanston, with the co-operation of D. E. Walker, and an extensive study in Detroit in co-operation with Lena A. Shaw. In Evanston the method which was compared with the film was the one customarily in use in the school. In Detroit, two other methods were compared with the film. The first method consisted in teaching position in the ordinary manner, with emphasis on individual instruction,

and in addition to this conventional procedure, it consisted in informing the children individually of their scores in position. The group with which this method was used is designated as Group II. With another group only the conventional method was used. This group is designated Group III.

The results of the experiments are based upon two methods of comparison. In the first place the parallel groups of children were compared with reference to the total scores which were

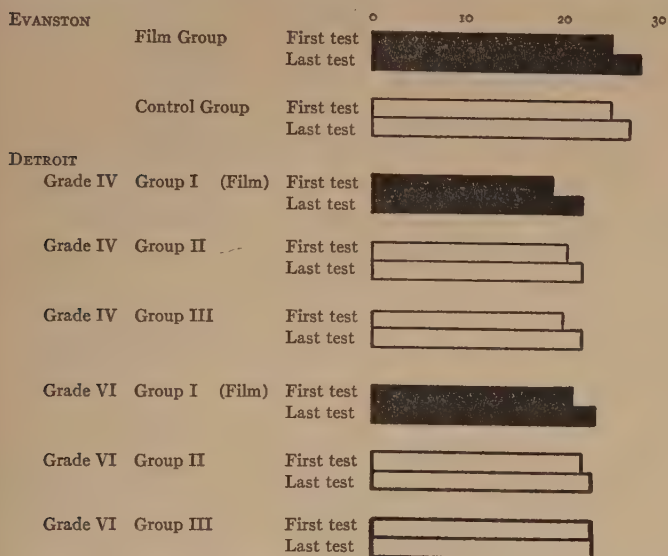


FIG. 18.—The gains in position in handwriting made by pupils taught by a motion picture film and by the usual method.

obtained by applying the score card. In the second place the changes which were produced by the instruction as indicated by the percentages of children who received the various scores on the particular items of position were examined in detail. This second type of examination made possible a more analytical statement of the results of the several types of teaching than could be gained from the total scores alone.

The comparison of the gains in terms of total points is shown in Figure 18. In the Evanston experiment the film group made

a gain of 2.9 points, while the control group made a gain of 1.8 points. The percentage of possible gain made by the film group was 41; the percentage of possible gain in the control group was 26. These percentages compare rather closely with those made in the more extensive Detroit experiment. In Grade IV A classes in Detroit, the film group made a gain of 3.1 points, whereas the other two groups gained 1.3 and 1.8 respectively. The percentage of possible gain by the film group was 39, and the percentage of possible gain by the other two groups was 20 and 27 respectively. In Grade VI A classes the median gains in points were 2.1 for the film group and .7 and .4 for the other two groups. The percentage of possible gain was 38 for the film group and 15 and 9 for the other two groups. The average of the percentages of the film groups was .385 and of the other two groups .188.

For the details of changes in the different items of position the reader may be referred to the detailed report of this experiment. The gains which were made by the film group were greater than those of the other groups in nearly all of the items of position. The value of the film for teaching position appears, therefore, to be rather well established.

8. Comparison of Motion Pictures, Slides, Stereographs, and Demonstration as Means of Teaching How to Make a Reed Mat and a Pasteboard Box, by F. D. McClusky and H. Y. McClusky

The traditional method of instruction in craftsmanship has been the method of demonstration supplemented by criticism and oral direction. The problem of these experiments is whether pictorial methods can be substituted for demonstration, and, if so, which of several pictorial methods is the best. If pictures give as good results as demonstration by a teacher it is possible that they can in many cases be advantageously substituted for demonstration. Pictures may be more economical because they are cheaper than is the technical education of the teacher, or because larger numbers can see them clearly than can witness a demonstration.

Two projects were used in making these comparisons—making a reed mat and making a pasteboard box. Both were used in the intermediate grades. The same experiments were made in the public schools of Urbana and Cleveland. The pictorial materials were constructed especially for this experiment. First a motion picture film was made by taking a photograph of an expert in the act of making the two objects, and inserting explanatory subtitles. Then a series of lantern slides was made by photographing the demonstrator at points in the action which represented significant stages in the performance and by adding to these other slides which contained subtitles similar to those included in the film. Finally, stereographs were made of the same scenes as appeared on the slides.

The four methods just described were compared by using them with parallel groups of children. Time and all other conditions which might effect the result aside from the methods being compared were kept as constant as possible. The efficacy of the methods was judged by scoring the boxes and mats which were made by the children in the various groups.

The results of the experiments are shown graphically in Figures 19-22. We may first consider the experiment with the box. Two groups of comparisons were made: first, a comparison of the effectiveness of the film, demonstration, and slides; and second, a comparison of film, demonstration, slide, and stereograph.

The comparison of the film, demonstration, and slide was made both in Urbana and in Cleveland. There are three comparisons in all. In each case the demonstration produces the best result. The film comes second in two of the cases and the slides last. In the third case the film and the slide are about equal.

In the three cases in which a comparison of four methods was made, the film, demonstration, and slide occupy the same relation to one another—the demonstration giving the best results, the film the second, and the slide the poorest. The stereograph stands second to the demonstration, and, as is shown in the summary graph, excels both the film and the slide. The results in

the different groups are sufficiently consistent to indicate that the differences which appear are genuine differences and are not due to accident.

How, then, may we interpret the results of the experiment? It appears from the superiority of the demonstration and the film to the slide that motion is effective in teaching this activity.

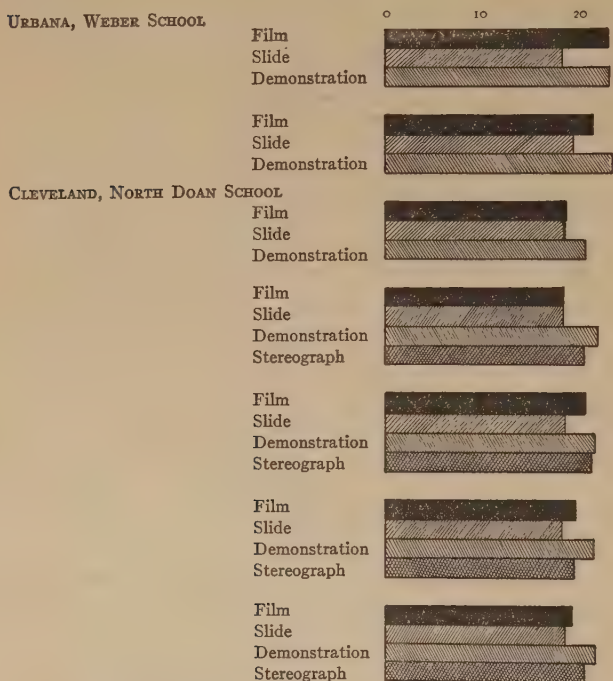


FIG. 19.—Comparison of effect of film, slide, demonstration, and stereograph in teaching how to make a pasteboard box.

The pupils, in other words, can get a better idea how the activity is to be carried out by watching the sequence of motions than by seeing a succession of pictures each one of which represents a successive stage in the activity.

The superiority of the demonstration over the film seems to indicate that there is a distinct advantage in the actual personal presence of the instructor. We must remember that in this case

the film gave a photographic representation of the hands of the instructor making the box. The picture started with a bust view of instructor but faded at once to a close-up of his hands. The picture duplicated the action of the instructor, therefore, as closely as it would be possible to duplicate it. It is often pointed out that the film has the advantage over the instructor of being enlarged and of being equally plainly in sight to all the members of the class. Since the demonstration gives superior results, there must be advantages in the presence of the teacher who is making the box to more than counterbalance these advantages of the film. We shall consider the possible explanation of the superior effect of the personal instruction over the film in connection with other experiments in which the same comparison was made.

We may consider now the relation of the stereograph to the other three methods—the film, demonstration, and slide. Three comparisons were made. The superiority of the stereograph to the film and the slide is of interest particularly in view of the fact that the stereograph does not represent motion. It is still, however, inferior to the demonstration. There must be, then, some feature about the stereograph which renders it particularly advantageous in comparison with the slide and the film, but which does not render it superior to demonstration.

The stereograph, of course, has the special characteristic of representing depth or of bringing out the third dimension. This characteristic of the stereograph seems to be of particular value in showing how the box is made, because it brought out more clearly than did the slide or the film the way in which the paper was creased in the successive pictures. The process of making the box consists first in folding it and making creases, and then in folding up the paper into the form of the box and pasting the parts together. An essential part of this whole process is the correct folding, cutting, and creasing of the paper. It was this, apparently, which was shown especially well in the stereograph.

Before commenting further upon these differences between the methods we may examine their comparative effectiveness in teaching the mat.

In the experiments with the mat the comparison was made in four cases between the film, demonstration, and slide (see Fig. 20). In every case the demonstration gave the best result. In this respect the mat experiment corresponds with the box experiment. In two of the cases the slide gave better results than the film, but in two other cases the film excelled the slide. On the combined scores, then, the film gave slightly better results than the slide, and the demonstration decidedly the best of all. We may defer further comment upon these results until the other comparisons have been scrutinized.

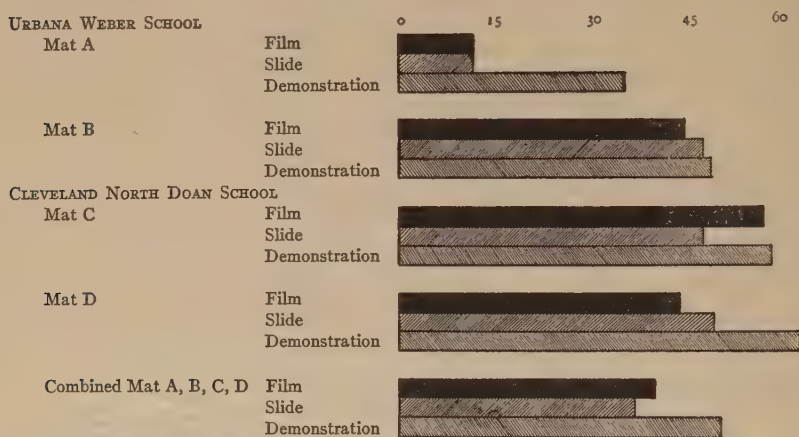


FIG. 20.—Comparison of the effectiveness of the film, slide, and stereograph in teaching how to make a reed mat.

In four cases a comparison was made between the film, demonstration, and stereograph (Fig. 21). These results are combined in a single graph. In two of these four cases the film excels the demonstration, though in one of them only slightly. Taking all of the groups together, the demonstration gives the best results and the film the second, while the stereograph is last.

The final comparisons were made between all four methods (Fig. 22). In each of these three comparisons, the demonstration is ahead. In two of them the film is second, while in the third

the slide is second. In two cases the stereograph is last and in one case the film is slightly below the stereograph. On the whole, then, in this group of comparisons, the demonstration is the best, the film is second, with the slide a close third, and the stereograph the fourth.

We may sum up the comparisons in the mat experiment and compare them with the results of the box experiment. The demonstration again comes out ahead. It is clear that there is some important characteristic which the demonstration possesses and which renders it on the whole the superior method.

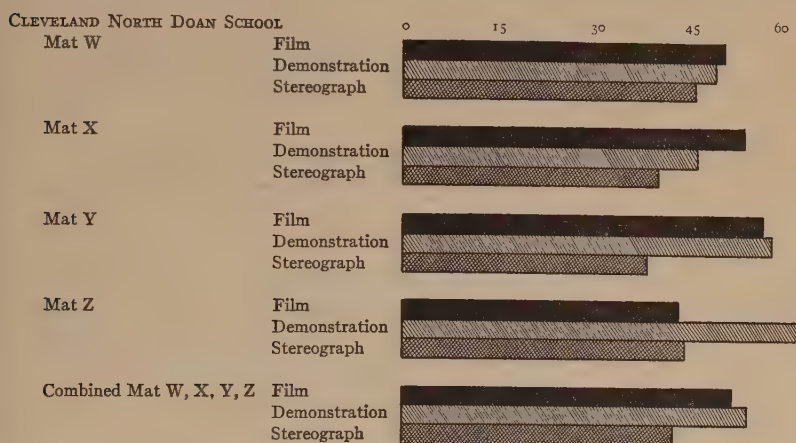


FIG. 21.—Comparison of the effect of film, demonstration, and stereograph in teaching how to make a reed mat.

The stereograph does not possess the distinctive advantages in the mat experiment which it does in the box experiment. This may be explained perhaps by the fact that the still pictures of the mat or the motion pictures of the mat bring out in sufficient relief the positions of the reed in relation to one another, and that it is not necessary that they be shown in the binocular perspective of the stereograph. In other words a flat picture apparently shows readily enough which of the reeds are in front and which are behind. This is indicated by the fact that the slide gives fully as good results as the stereograph.

The fact that the slide and the stereograph give approximately as good results as the film, on the whole, requires an explanation. It appears that the still pictures are able to show the method by which the successive stages of the act in making the mat are produced and that motion is not necessary to give a clear idea of how these acts are carried out. The superiority of the demonstration, therefore, cannot be primarily in that it represents action, but must be in the personal relation of the instructor to the class and the ability of the instructor to adapt himself to the attitude of the pupils.

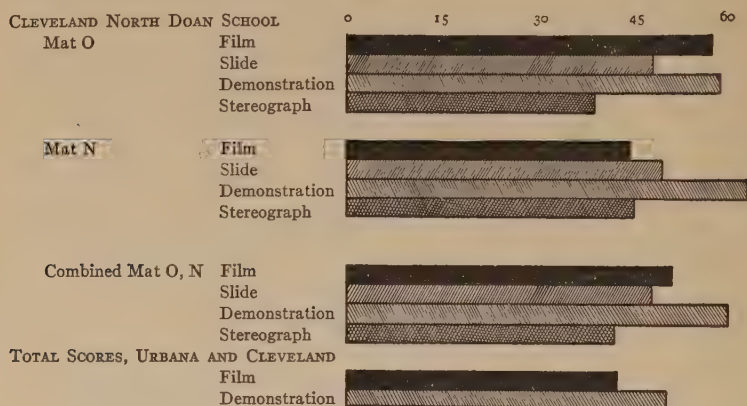


FIG. 22.—Comparison of the effect of film, slide, demonstration, and stereograph in teaching how to make a reed mat.

In general, it appears that one picture method may be superior for teaching one type of act and another method for another act.

9. A Comparison of the Effectiveness of a Motion Picture Film and of Demonstration in Instruction in High-School Physics, by E. C. Rolfe

A comparison of the effectiveness of demonstration and of the motion picture has already been made in the experiment with the box and mat. This experiment deals with operations requiring manual skill. The present experiment deals with a subject

requiring a grasp of scientific principles and the manipulation of apparatus in such a manner as to reveal and illustrate them.

The experiment consisted in showing to two groups of high-school students a film on static electricity and making a demonstration on the same subject to two parallel groups. The four groups were given two tests, one a verbal test and the other a test in laboratory manipulation. The standing of the combined

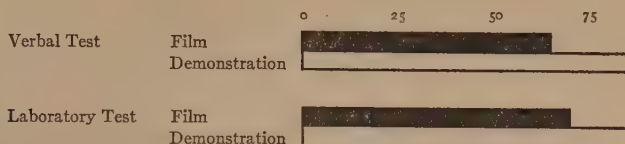


FIG. 23.—A comparison of film and demonstration in teaching physics

film groups and of the combined demonstration groups is shown in Figure 23.

The superiority of the demonstration group over the film group is strikingly large and remarkably similar in the two tests. The results agree in direction with the other experiments with the demonstration method. The experiment appears to show without question that the teacher's presence and presentation of the subjects is decidedly superior, so far as certain subjects are concerned at least, to the impersonal presentation of the motion picture. The interpretation of this fact will be left to the general summary.

10. A Comparison between the Motion Picture Film and Demonstration or Oral Instruction in the Teaching of Cooking, by A. P. Hollis

In this experiment a motion picture film was compared with a demonstration of the same lesson and with oral instruction by the teacher. The effectiveness of the instruction was tested by performance, that is, the pupils were required to repeat the processes which had been taught them. The experiment deals with home economics as taught in the seventh and eighth grades.

The film used was *How to Make an Omelet*, produced by the Gibson Studios.

Several experiments were made with the film which shows how to make an omelet. It was shown to groups of classes in cooking in the seventh and eighth grades, and with it were compared oral instructions and demonstration in other parallel groups. In some of the groups the number of cases was rather small, and in others one of the parallel groups belonged to a different grade from the other two. This was contrary to the plan of the experiment and in a measure vitiates the comparison. We may, how-

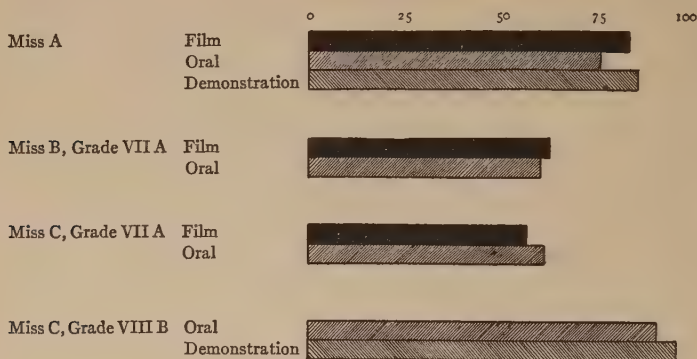


FIG. 24.—Comparison of the effectiveness of the film, demonstration, and oral instruction in teaching how to make an omelet.

ever, examine the results for what they are worth. The results are shown in Figure 24.

In the first comparison it will be seen that the demonstration gave the best results, the film the next best, and the oral instruction the poorest. It should be noted that in these experiments, as in the experiments with the box and with the reed mat, the test consisted in making an object rather than in a verbal test or examination. In the second series of groups which were taught by Miss B, the film group made a higher score than the oral group. The demonstration made the highest score of all, but they belonged to a higher grade. In a third comparison the oral group made a higher score than the film group. The demonstra-

tion group made the highest score, but again this group belonged to an advanced grade. In the last comparison the oral and the demonstration groups belonged to the eighth grade. The demonstration group made the highest score. The film group made a slightly lower score than the oral group, but the difference may be due to the fact that it belonged to a lower grade. In general it appears reasonable to conclude that the demonstration, as in the case of the mat and the box experiment, gave the best score and may be regarded as superior. The film group made a slightly better score than the oral group, but in some cases the relation was reversed. We may conclude, perhaps, that in those cases in which the pupils have had sufficient experience with the materials of instruction they may be satisfactorily taught by the oral method, but that where their experience has not been sufficient, it is necessary to supplement the oral instruction with concrete experience through pictures or other methods.

II. An Experiment in the Use of Stereographs and Slides in Teaching Oral English to Adult Foreigners, by Nina L. Beglinger

This experiment was made in the Detroit Public Schools in teaching English to foreigners. The aim of the experiment was to determine whether groups of adults could be more effectively taught oral expression in English by the aid of pictures than by the ordinary method of oral instruction. The pictures were used systematically for individual study. Thirty-five stereographs were prepared with printed descriptions on the back. The students studied these individually and then came together for a group exercise in which slides were thrown on the screen and conversation was carried on concerning them. The slides duplicated the pictures in the stereographs.

This method was used with four sections comprising ninety-one individuals. The ordinary method in which pictures were used incidentally and dramatic method was employed was used in four parallel groups. The relative gain of the two groups

was measured by giving the same test before and after the training to both the groups. This test consisted in presenting 175 words and asking the subjects to give sentences containing them.

The gains made by the groups which saw the pictures were nearly twice as great as those made by the groups which did not see the pictures. The control group gave 144 sentences at the start and 482 sentences at the close, while the picture group gave 167 at the start and 828 at the close. There seems to be ample evidence that the pictures were very effective means of instruction. A somewhat more detailed statement is given in the individual report of this experiment.

12. Study of the Value of Motion Picture Films as a Feature of Health Education, by Caroline Hoefer and Edna Keith

Visual materials have been used extensively in health education, partly to make ideas clear and partly to stimulate interest. They are highly prized by teachers of this subject, particularly for their effect in stimulating interest. Projects are also extensively used in this department of instruction. The object of this experiment was to study, not the effect of pictures in general, but of motion pictures in particular in health instruction.

The opportunity offered itself to make this study in connection with the work which is being carried on through the co-operation of the Elizabeth McCormick Memorial Fund of Chicago and the Public Schools of Joliet, Illinois. The object of this work is to instruct the children in the principles of health and to develop in them health habits. The instruction is concerned with such matters as sleep and rest, outdoor exercise and play, and properly selected and adequate food. The instruction is varied and includes both seeing pictures and making them.

The present experiment consisted in dividing 346 grade children situated in several schools, comparable as to the class of children and type of neighborhood, into two groups, and giving one group all the regular instruction including eight motion pic-

ture films on health education and to the other group the same instruction minus the films. Both groups had the same subject-matter presented in the same manner to begin with. After each topic had been studied by both groups the film group saw the appropriate film on the topic and the non-film group had an oral review. The films used were *The Knowing Gnome*, *The Story of the Orange*, *Milk the Perfect Food*, *The Romance of the Milk Bottle*, *The Four M's*, *Mrs. Brown and the High Cost of Living*, *Guard Your Mouth*, *The Gateway to Health*, and *Toothache*. The instruction lasted for a period of six weeks.

The tests in this experiment were designed with the purpose of measuring the effect of the instruction on behavior and not merely on the acquisition of information. An information test was used in order to determine whether the films were particularly effective in giving information, but great stress is laid also upon three other tests. The first of these is a record of weight. Previous experience had shown that health instruction caused greater increase in weight than would otherwise have occurred. It was inferred from this fact that differences in the effectiveness of instruction would be reflected in different amounts of gain in weight. The second of these tests is called the clockface test from the blank which was used in giving it. The test consists in securing a record from the children each morning for a period of a week at a time on two points: first whether they were in bed ten hours the previous night, and, second, whether they slept with windows open. Each child made his own record on the figure of a clockface which was printed on his blank. The third test, besides the information test, was a questionnaire similar in principle to the clockface test. Each child was required to report at intervals whether he drank coffee, tea, or milk for breakfast, whether he ate cereal and fruit, etc. The complete list is shown in Figure 27. This group of four tests is thought to be reasonably adequate to measure the difference in the effectiveness of the motion picture films and of oral discussion as a means of reviewing and driving home instruction in health, if such difference exists.

Perhaps the most fundamental test is the gain in weight of the two groups which is shown in Figure 25. In the case of both the median and the average gain the non-film group made a definitely greater gain than did the film group. That this greater gain is due to the superior effectiveness of the oral instruction is doubtful, in view of the results of all the tests taken together. It is, however, a conservative statement to say that, so far as the most objective tangible outcome of instruction is concerned, the use of films did not produce greater gain than did oral instruction.

The second, or clockface test, was given to determine how effective the instruction was in inducing the children to secure ten hours of sleep and to sleep with open windows. The children

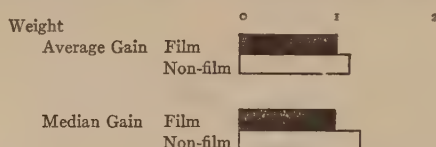


FIG. 25.—Comparison of the gains made by the film and the non-film groups in weight.

reported on a specially prepared blank containing figures of clockfaces, each morning for one week at the beginning, and another week at the end of the experiment, the hours of retiring and rising and whether they had had a window open during the previous night. The gains of the two groups, in percentages of individuals who came up to the standard, are shown in Figure 26.

It appears that in both the number of hours of sleep and in sleeping with open windows the film group gained slightly while the non-film group lost slightly in the first case and just held its own in the second. This evidence is contrary to that of the gains in weight, though the difference between the groups is less marked. We may then turn to the third test.

The third test is one of information. The pupils were given, at the end of the experiment, a test on the subject-matter of instruction. The test was made up of the familiar forms,

completion, multiple-answer, and disarranged sentences. The highest possible score in this test was 48. The median score of the film group was 17.9 and of the non-film group, 21.4. (See the graphic representation in Fig. 26.) As judged by McCall's formula for the reliability of a difference it is practically certain that this difference is a real one. In order to determine the mental ability of the two groups they were given the Trabue Completion Test. The averages were practically equal. This

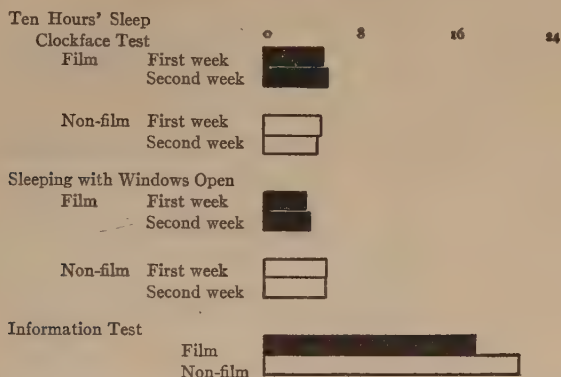


FIG. 26.—Comparison of the gains made by the film and the non-film groups in terms of the percentage who slept ten hours and who kept the windows open, and in the information test.

indicates that the difference in the test scores is probably due to the methods of instruction.

The final measure of efficiency is a questionnaire given before and after the experiment, to determine what change took place in the percentage of children who observed certain rules of health. The results are summarized in Figure 27. The chart represents the percentage of pupils who performed certain acts, or in the case of the last two items, testified that they knew certain acts should be performed, before and after the instruction. In the case of the first two items, of course, a decrease means improvement, while in the remainder an increase means improvement. In the case of the following items the film group made definitely greater improvement: in the behavior concerning drinking

coffee, drinking tea, and brushing teeth, and in the knowledge concerning amount of sleep needed and amount of drinking water needed. In eating fruit and in keeping windows open the

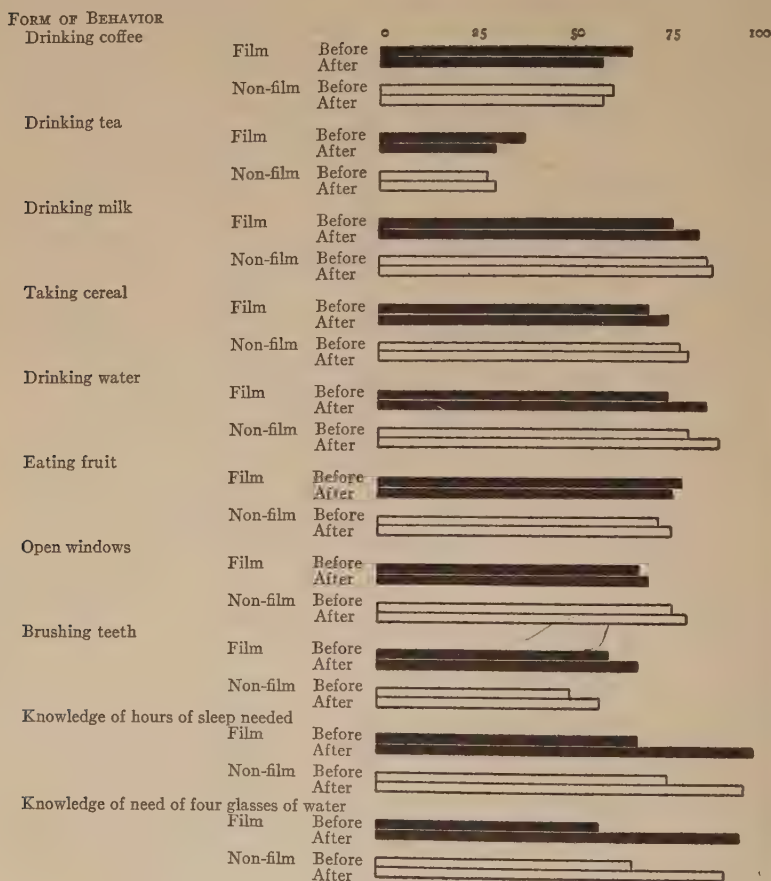


FIG. 27.—Changes in behavior or attitude as indicated by the response to the questionnaire.

non-film group made the greater gain. In drinking milk, taking cereal, and drinking water the film group made a slightly greater gain but the non-film group was so near 100 per cent at the end that it may have been near the limit of improvement. On the

whole the film group made somewhat greater gains than the non-film group, and curiously enough, its superiority was greater in the tests of knowledge than in the tests of behavior.

What is the practical conclusion of the experiment? The films which were used in this experiment were designed to stimulate interest and to incite to behavior. They were not designed to give experience which had not been gained by other means, or which could not be gained by other means. Their purpose was not primarily to give new knowledge but to drive it home and make it operative in the children's lives. Did the films prove to be particularly effective in accomplishing this purpose when they were used to supplement varied instruction which included oral instruction, discussion, and a great deal of project work, some of which included making books of pictures and other types of manual activity? We must conclude from the results of our tests that they did not. At least the burden of proof must be upon one who advocates films for use under the circumstances of this experiment.

13. An Analytical Study of the Content of Educational Motion Picture Films, by H. Y. McClusky

Reference has been made to the character of some of the motion picture films which were used in this investigation. We have seen, for example, that the film, *Railroads in the United States*, contains less than 50 per cent of pictures of action. Nearly 40 per cent consists of subtitles. If the maps on which there is a small amount of animation were excluded from the class of action pictures the percentage would be far below 40. The fact that this film is somewhat inferior in effectiveness to the ordinary procedure of the lecture raises the whole question of the content of motion picture films. We are led to inquire how far motion is actually represented by them and how far they merely duplicate the simpler and less expensive reading text, slide, chart, still picture, or oral lecture.

The study by H. Y. McClusky answers these questions for a list of 100 representative educational films.

The first fact which strikes the attention as one examines the table which gives the amount of footage in the various educational films devoted to the three types of material—subtitles, pictures of still objects, and pictures of moving objects—is the enormous variation in the character of the films. One might suppose that motion pictures would be designed mainly to represent motion. The proportion of footage devoted to picturing motion varies in the different films from 88 per cent to zero. (Five films which picture an instructor making a chalk talk are excluded from this comparison as being of a special nature.) The film which contains the largest percentage of motion is one on power farming and the one which contains the least is entitled *Midsummer Wild Plants*. The first film is composed of subtitles to the extent of 12 per cent and contains no still pictures. The second film is 43 per cent subtitles and 57 per cent still pictures.

These are extremes but they are by no means isolated cases. The films are fairly evenly distributed along the scale from those at one extreme which show little action to those at the other extreme which show much.

The second fact of note is that classes of films appear to differ in the relative amount of subtitles, still pictures, and motion pictures. The distribution for six classes is shown in Figure 28. The films which show manufacturing processes appear to differ among themselves rather widely, the majority containing chiefly pictures of motion, but a minority containing a large proportion of subtitles. This group was, therefore, subdivided.

The third striking fact is the large portion of educational motion pictures which is devoted to verbal explanation and comment (subtitles) and to pictures of still objects, especially in certain classes of films. Taking even the average of all the films we find that one-third of the footage is given over to reading matter pure and simple, and nearly one-eighth to picturing still objects.

If visual experience is so pre-eminently effective as some of the proponents of visual education would have us believe, one is led to inquire why many of the educational films do not contain more of it. This question is particularly pressing with reference to the four groups in which less than half the footage shows motion. These groups include twenty-five films. In the biology films, of which there are five, only one-quarter is motion.

The obvious suggestion from these facts is that educational motion pictures have been made up to a considerable extent without due regard to their distinctive function. There appears

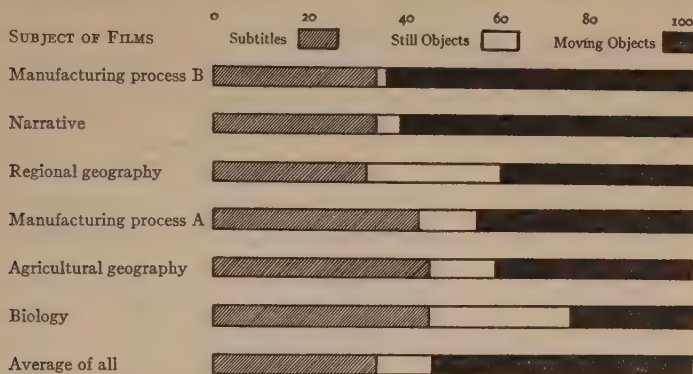


FIG. 28.—The proportion of various classes of educational motion pictures devoted to subtitles, pictures of still objects, and pictures of moving objects.

to have been a prevalent belief that subject-matter presented by the motion picture film acquires, by virtue of this fact, a magic effectiveness regardless of whether or not it is actually different in essential character from the same subject-matter presented in some other form. In fact, there is no a priori reason to suppose that motion picture presentation is in any way superior to other forms—such as slides, charts, or pictures accompanied by oral discussion—unless the content is different essentially from that which can be presented otherwise. The results of the experiments reported in this monograph give color to the opinion that mere presentation by motion pictures is not of itself of any advantage.

It is obvious from a consideration of the difficulties and the expense attendant upon the production, distribution, and projection of educational motion pictures that their contents should be limited to subject-matter which cannot as well be presented in any other way. The survey of representative educational films which has been here reported suggests that this guiding principle deserves closer observance than has been given it.

This is a particular case of a more general question which is raised by the study. This question is whether the motion picture contributes new experience to the child or experience which cannot readily be obtained by a more convenient means. We may draw a distinction between radically new raw experience and the elaboration, reorganization, or application of old experience. It seems likely that motion pictures are particularly adapted to give certain kinds of new experience, but they may not be especially valuable for re-working old experience. A further discussion of this point will be given in the general summary of the entire series of experiments.

DETAILED SUMMARY OF FINDINGS

1. The oral lesson achieved approximately the same result as the motion picture film in the experiment with the film, *Reclaiming Arid Lands by Irrigation*, at Detroit.

2. The oral lesson resulted in a slightly higher test score than did the film in the experiment with the film, *Orange Culture*.

3. Oral instruction gave uniformly poorer results in one school and poorer results in one out of three tests in the second school, as compared with instruction which included motion pictures, slides, stereographs, and models, in a four weeks' experiment on the geography of Egypt.

4. In James's preliminary experiment with three films, oral instruction gave better results in one case and poorer results in the other two. In James's final experiment with six films, oral instruction gave about the same result in two of the cases and decidedly inferior results in the other four.

5. In McClusky's earlier experiments:

a) The film entitled *French Explorations in the United States* was not as effective as oral instruction with maps.

b) A stereopticon lecture was more effective than the film entitled *Panama Canal and Its Historical Significance*.

c) Oral instruction illustrated by stereopticon slides and oral instruction illustrated by pictures and sketches were about equal to the film, *The Life History of the Monarch Butterfly*.

d) Film instruction accompanied by oral discussion during the showing of the film was slightly more effective than oral-chart instruction, both of which in turn are distinctly more effective than the film unaccompanied by oral comment.

e) Oral instruction illustrated by maps and followed by film instruction was more effective than the film seen twice.

f) A stereopticon lecture followed by the film was more effective than the film seen twice.

g) The motion picture of a moving object was more effective than still pictures of the object.

h) In the experiment with the film, *Canals in United States History*, oral discussion accompanying the film-showing in which the film was stopped from time to time was more effective with one group than the film shown twice unaccompanied by oral discussion. In the second group the film shown without discussion was slightly superior to the film accompanied by discussion.

i) Oral instruction illustrated by charts was superior to film instruction in each of two experiments with the film, *Waste Disposal in Cities*.

j) Place sequence was taught more effectively by oral instruction illustrated by maps or charts than by film instruction in the films, *French Explorations in the United States* and *Panama Canal and Its Historical Significance*.

k) In each of three experiments with the film, *The Story of a Mountain Glacier*, a blackboard chalk talk was more effective than the film.

l) In an experiment with the film on glaciers, oral instruction illustrated by stereographs was superior to oral instruction

illustrated by slides which in turn was more effective than the film.

m) An analysis of test papers from the experiment with the film *Waste Disposal in Cities* shows that the film needs elaboration and explanation at various points to make it as effective as oral-chart instruction either in teaching a place sequence or in presenting a picture or chart for analytical study.

n) In teaching the geography unit, Middle Atlantic states, stereographs used during the study period appeared to be slightly more effective than slides used during the recitation.

6. In the tests of delayed recall there was less loss in the scores of the film groups than of the parallel groups in every case but one. In every case but one, however, in which this was true, both the score on the first test and the residual score of the film group were smaller than were the scores of the parallel groups.

7. In three comparisons of the attention paid by pupils to the film, *The Story of a Mountain Glacier*, and to an illustrated lecture, there was no advantage on the side either of the film or of the lecture.

8. In a comparison between the effectiveness of the film, *Railroads in the United States*, which contains a large number of tables and diagrams, with the effectiveness of the printed text, the printed text was less effective than the film. In the experiment with the film *Iron and Steel*, the illustrated text, which was made up of still pictures taken from the film and of the subtitles of the film, was as effective as the film and the slide.

9. In two of James's experiments, stereopticon pictures, alternating with projected subtitles, were less effective than moving pictures of the same scenes alternating with the same subtitles. In the Cleveland experiment with the film, *Lumbering in the North Woods*, the film gave better results than stereopticon pictures alternating with subtitles. In a similar experiment with the film, *Iron and Steel*, the stereopticon pictures gave slightly better results than the film.

10. In the comparison between the film, *Railroads in the United States*, and an oral lecture accompanied by tables, diagrams, and maps, the oral lecture was superior.

11. In two of McClusky's experiments and one of James's oral comment accompanying the motion picture film added to its effectiveness. In all the experiments with the films, *Iron and Steel* and *Lumbering in the North Woods*, oral comment added to the effectiveness of film, slide, and illustrated text.

12. In one case music accompanying a film raised the test scores of girls but not of boys.

13. In teaching a lesson on electrostatics to high-school students a motion picture film was compared with demonstration by the teacher. Demonstration was markedly superior.

14. In Hollis' comparison of a motion picture film, as an introduction to a lesson, with an oral introduction, the group which saw the film made a higher score on the lesson test than did the oral group. In James's more extensive comparison of the effect of the film and of an oral lecture as an introduction to a reading lesson the film group was superior in one case and the oral group in the other.

15. In teaching position in handwriting, a motion picture film was superior to the ordinary method, and it was also superior to the ordinary method supplemented by the procedure of giving the pupils their scores.

16. In teaching how to make a reed mat, demonstration by the teacher was the most effective, the film was next most effective, and the slide and the stereograph were somewhat less effective than the film.

17. In teaching how to make a pasteboard box, demonstration was most effective, the stereograph was next, and the film and slide stood third and fourth in the order of effectiveness.

18. In teaching how to make an omelet, demonstration was the most effective. The film was superior to oral instruction in two comparisons, while in a third comparison oral instruction was superior.

19. The presentation of a series of eight films as part of a six weeks' course of instruction in health education was compared with oral reviews. The results as a whole were not decidedly favorable to either group. The film groups were superior as measured by their reports of their own faithfulness in carrying

out the instructions they had received, while the oral group was superior as measured by a test on subject-matter and by their gain in weight.

20. A study of the content of 100 representative educational motion pictures, indicated that (*a*) on the average but 54 per cent of the footage consists of pictures of motion, while about one-third is occupied by subtitles; (*b*) that individual films vary greatly, some containing no pictures of motion whatever while others contain nearly 90 per cent of pictures of action; (*c*) that various types or classes of pictures differ in the percentage of film which they devote to action.

CHAPTER III

FINAL SUMMARY AND INTERPRETATION

1. *The relative effectiveness of verbal instruction as contrasted with the various forms of concrete experience represented in visual education, depends on two major conditions, the nature of the instruction to be given, and the character of the pupils' previous acquaintance with the objects which are dealt with in the instruction.*

This major principle is supported, in the first place, by the fact that the relative effectiveness of verbal and visual instruction varies. At Detroit, oral and film instruction were found to be equal in the orange culture and irrigation experiments while the film surpassed oral instruction in the Egypt experiment. In James's experiments oral instruction proved to be as effective or nearly as effective as motion pictures in the case of certain films, but decidedly inferior in others.

The contrast which is here drawn is between concrete experience, on the one hand, and the comparing, analyzing, and generalizing operations on the other hand. The contention is that these latter ways of working over experience and of converting raw experience into thought are very much facilitated by language, if they are not, in fact, largely dependent upon it. Certainly communication of general or abstract ideas is very clumsy and difficult without language.

The distinction which is commonly drawn, in discussing visual education, is not between sensation and thought, but rather between one sense and another. Vision is contrasted with the other senses—with hearing, which is identified with language, and with touch, taste, smell, etc. In making this distinction, the purpose is to attack language, which is represented by the sense of hearing. Nobody proposes to set up direct experiences with objects through hearing, touch, smell, or taste as competitors for pre-eminence with sight. The issue is not between the sense

of sight and the other senses. It is between concrete or sensory experience and thought.

These facts of the study suggest that pictures may be useful for presenting some types of subject-matter. Doubtless no careful thinker would question this. That pictures have a legitimate function is obvious. So far as words are concerned, the very constitution of many of the educational motion picture films themselves indicates that their authors find it difficult, if not impossible, to present some subjects, or some aspects of subjects, by means of pictures alone. In some cases they resort to verbal discussion and explanation to a very large extent. A striking example of the use of much verbal material, and tabular material of a similar nature, is to be found in the film entitled *Railroads in the United States*. This, however, is by no means an isolated instance. The study of the content of films, made by H. Y. McClusky, indicates that many writers of scenarios for educational films, finding themselves unable to express the ideas they wish to express by pictures, resort to language.

The present study gives no support to a belief that pictures may be substituted for language. It does indicate, however, that they have a definite function to perform. This function is determined by the nature and purpose of the instruction. The purpose of instruction at one time is to lay the foundation for thought, reflection, generalization, application. This foundation consists in direct experience with material objects. At another time the purpose is to build upon this foundation the superstructure of thought. The analogy should not be pressed, since it implies too much separation in time and space between concrete experience and thought; but it serves to set forth the distinction between getting experience through contact with the material world and the elaboration of that experience.

The evidence is that pictures are an invaluable means of getting certain kinds of experience of a concrete sort. In the detailed reports some light is thrown on the particular kinds of instruction which may be served especially well by pictures. The analysis of the curriculum, in order to determine what can

advantageously be taught with the aid of pictures, is, however, only begun. This investigation will have served a purpose if it emphasizes the need of such analysis.

That the character of the pupils' previous experiences is also an important condition which determines whether visual or verbal instruction is the more important is suggested by some of the variations which appeared in the results of the experiments. For example, in Hollis' cooking experiment the group which made a high score after oral instruction had previously had five months more instruction in cooking than had the other groups. Their superiority may be due in part to their ability to grasp oral directions because of this previous experience. In James's experiment, oral instruction proved to be relatively effective in the preliminary experiment with the film, *The Queen of the Waves*, and in the later experiment with the films, *Yellowstone Park* and *Toads*. On the other hand, oral instruction was clearly less effective in the case of the films, *A Woolen Yarn*, *Cuba*, *The Isle of Sugar*, *Lumbering in the North Woods*, *The Mosquito*, *Through Life's Window*, and *Waste Disposal in Cities*. The first group of films describes objects or processes which the child can understand or interpret in the light of his past experience. For example, *The Queen of the Waves* deals with the development of the forms of water conveyance—the log, raft, dugout, canoe, sailboat, steamboat, etc. The children had doubtless either seen all these objects, or at least pictures of them. *Yellowstone Park* deals with forms of natural scenery, which, again, the children may have seen pictures of or which are sufficiently like objects they have seen to be comprehended from a verbal description. Similarly with the film, *Toads*. The second group on the other hand, deals with detailed processes, such as those of manufacture, or with more or less intricate or abstruse biological facts, such as the development of the mosquito or the structure of the eye, which the child cannot picture in terms of his previous experience.

This study has only opened up the problem of determining in detail at what points the child's experience with the material

world is adequate to serve as the basis of the development of the ideas which we wish to develop, and at what points it needs to be supplemented by further direct experience. Further research is necessary and will be necessary for many years. This further investigation should deal with each subject or division of instruction intensively, and should analyze the curriculum and the method of instruction with reference to this problem from the first grade up.

Our first conclusion deals in general with the relationship between visual education as a representative of concrete instruction and the more abstract verbal instruction. The larger portion of the investigation was concerned more particularly with a comparison and analysis of the various forms of visual education than with this more general relationship, and we now turn to a consideration of this more detailed study. The most frequent comparison which was made was that of the effectiveness of a motion picture film and of some other form of visual instruction.

2. *The comparison of the motion picture film with other visual aids—slides, stereographs, still pictures—as means of informational instruction, indicates that the motion picture is superior within a restricted range of subjects, and that outside this range of subjects the older devices are as effective or more effective than motion pictures.*

The most striking case in which the film gave superior results was in McClusky's experiment in which a portion of the steamboat film showing the motion of the steamboat, was compared with a still picture of the same object. It is significant that, in order to obtain a film for comparison which would be chiefly a picture of motion it was necessary to abstract a portion from one of the existing films. When such a portion was abstracted and isolated for comparison it gave superior results.

James also found the film to be superior to still pictures. In his comparisons, verbal explanation was shown alternately with still pictures just as subtitles alternate with motion pictures in a film. The verbal explanation used by James was a copy of the subtitles of the film. If we take these results alone they

seem to indicate that the pictures of objects in motion make a stronger impression or give more information than do still pictures. It happens that in the Cleveland and Chicago experiments the film, *Lumbering in the North Woods*, was also used, and the comparison between film and slide was made which indicated the film to be superior. But when the same comparison was made with the film, *Iron and Steel*, the slide proved to be fully as effective as did the film. Whether this difference is due to the nature of the subject-matter or to the difference in the merit of the films we cannot say. We can only say that, in some cases, motion appears to add to the effectiveness of the pictures, while in other cases it does not.

In the application of this conclusion we must take account of the fact that the manner of using still pictures which was observed by James, in order to parallel the films as closely as possible, is inferior to the usual method of discussion during the viewing of the picture. The comparison which has just been described was made to discover whether motion adds to the effectiveness of pictures which are otherwise alike. The comparisons which are about to be described were made to determine how the motion picture compares with the usual still-picture-oral-comment procedure.

Our comparisons indicate that in most cases the informational motion picture films, as now organized, are not superior to slide, still picture, or stereograph accompanied by the usual comments. In many cases, particularly in McClusky's experiments, still pictures gave evidence of superior effectiveness. This conclusion runs counter to the opinion of many concerning the effectiveness of motion pictures and requires further analysis and explanation.

It has already been pointed out that there are some facts which can be grasped better by a view of objects in motion than by seeing them at rest. For example, the operation of a machine or the complex of movements which compose an act of skill are probably most clearly apprehended by means of the perception of the motion. But educational motion pictures have by no means confined themselves to such facts. A comparatively

small proportion of educational films deal with such content, and those which do contain much material which is not intended to promote the understanding of action.

Motion pictures, then, appear to have two grounds of merit. First, there are some cases in which the understanding of the action of an object requires that it be shown in motion. Second, it may be, though on this point we have less certain evidence, that motion makes objects attractive and as a consequence attracts close attention and prompts to better learning, even though it is not necessary to an understanding of the subject. The first type of advantage is so great as to justify motion pictures in those cases where it is essential to grasp the nature of a movement. The second type of advantage must be weighed in comparison with the advantages of still pictures.

The first advantage of the still picture appears to be that it permits analysis. The picture provides the opportunity for a more active study attitude on the part of the pupil. In the second place, the still picture gives greater opportunity to the teacher to exert a personal influence and to stimulate the class to active thought. Our experiments give clear evidence on the last-mentioned factor—the influence of the teacher. Its importance is indicated by the advantage of oral comment by the teacher during the showing of a film, by the superiority of demonstration in teaching certain acts of skill and by the superiority of the illustrated lecture to reading an illustrated text.

Thus far our discussion has dealt chiefly with the use of motion pictures and other visual aids in that type of instruction which aims largely at the acquisition of information by the pupil. A number of the experiments were made in subjects in which the information to be gained is of an especially concrete sort, as in science, or in which the pupil is required to learn to do something instead of acquiring information only, as in manual arts and to some extent in laboratory science.

3. *In teaching science, demonstration by the teacher is superior to the motion picture.* This proved to be true in both Hollis' and Rolfe's experiments. In both cases the proficiency of the

pupils was measured in whole or in part by their ability to perform or to do something, not merely by their ability to express their knowledge in language. Wherein the superiority of the teacher lies is a matter of speculation, but that it exists is clear. It seems likely that it may be accounted for in part at least by the influence of the teacher's personality in attracting and holding the attention of the pupils, and by the fact that the teacher can watch their behavior and vary the presentation by amplifying the discussion when they do not appear to understand or passing on when they have the point and are in danger of becoming bored. In our experiments the second factor could operate in only a minor degree since the demonstration was designed to duplicate the film.

4. *In teaching how to do or make something, demonstration, where it can advantageously be carried out, is superior to the film, but the film is superior to the methods with which it was compared, except demonstration.* The attempt has been made in this statement to combine the results of the handwriting experiment with the results of the mat and box experiments. It will be remembered that in the handwriting experiment the film was compared with the usual verbal instruction and with the procedure of giving the pupils their scores as means of improving the pupils' position. In this experiment demonstration was not used and it would probably have been difficult to use. The film excelled the ordinary method of teaching.

In the mat and box experiments, besides demonstration and the film, the slide and stereograph were used. The demonstration was superior in both. Taking the two experiments together the film came second in effectiveness, though it was slightly excelled by the stereograph in the box experiment alone. In the mat experiment the slide excelled the stereograph.

5. *Pictures appear to be very effective as devices to help in gaining proficiency in the oral use of a foreign language.* Whether the superiority of the picture group is due to the pictures themselves or to the fact that this group, through the use of the pictures, had more individual study, is not clear. In any case,

the method which involved the use of pictures appears to have been very effective.

6. *It does not appear that motion pictures are of outstanding and unparalleled value as means of awakening interest in a subject or of stimulating activity, in comparison with advanced modern methods of instruction.* This statement is contrary to a view which is rather widespread among specialists in visual education. The experiment in health education at Joliet was undertaken especially to measure this kind of effect. The chief object of the experiment was not to determine whether the motion pictures increased the pupils' stock of information more than did the parallel methods. Its object was more particularly to determine whether or not they caused the pupils to put into practice more faithfully the rules of health which their information showed to be beneficial. The motion pictures were shown after the topics with which they dealt had already been taught, and took the place of oral reviews. The pupils who were given the oral reviews in place of the pictures, besides making higher scores in the information test, made a greater gain in weight. To offset this, the film group reported in their answers to the questionnaire that they followed instructions somewhat more closely. The evidence is that the non-film group gained at least as much from their instruction as did the film group.

Part of James's experiments also bears on this issue. He measured the stimulating effect of moving pictures by testing the pupils on certain specified follow-up reading. In the original test on the film and the oral lecture the film groups were very superior, showing that these particular films were much more effective than the particular oral lectures which were compared with them as means of giving information. In the follow-up reading on the same subject, however, only one of the film groups was superior to the oral group, while the other film group was slightly inferior. We may then supplement the foregoing statement as follows.

7. *The peculiar value of the film lies in its ability to furnish a peculiar type of content of experience rather than in its generally stim-*

ulating effect. This conclusion is perhaps indirectly supported, again, by Hollis' comparison of the effectiveness of a film as an introduction to, and as a summary of, a small unit of instruction. The film proved more effective as an introduction than as a summary. Furthermore, it proved to be more effective as an introduction than was an oral introduction. The most probable explanation of these facts, in the light of our other data, is that the film, seen at the beginning, gave a background of experience which illuminated the subsequent lesson.

8. *Each of the common forms of instruction which employ visual aids has some advantage, and there are circumstances under which it is the best form to use.*

The distinctive advantage of motion pictures has already been discussed.

Slides have the advantage of cheapness and convenience in comparison with motion pictures and when used by a well-prepared teacher are very effective.

Maps can more effectively be presented in the form of slides or wall maps than in motion pictures.

Stereographs are particularly valuable when extensive scenes, or objects of somewhat intricate construction, are to be examined. They gave slightly better results than slides in McClusky's experiments in the field of geography instruction. They are more difficult to use with group discussion than are slides.

The illustrated text is the most convenient and the easiest type of visual material to use and its effectiveness is not greatly inferior to the other types of material. It is particularly useful as a means of rapid and wide distribution of new subject-matter, especially among schools which are taught by teachers of limited training.

9. *The usefulness of motion pictures would be enhanced if they were so organized as to confine themselves to their peculiar province.* Their province seems to be the exhibition of moving objects and particularly to facilitate the analysis of motion. They are outside their province when they show still objects or

when they enter the field of abstract verbal discussion. They cannot compete, in these respects, with still pictures and with the teacher.

10. *The superior effectiveness of the teacher as contrasted with any merely material device was indicated repeatedly in the investigation.* In spite of the undoubted attractiveness of the motion picture in general, McClusky found the attention of a class under oral instruction to be as high as that of a class which was shown a motion picture. Reading with pictures was found to be inferior to oral lecture with pictures in McClusky's Cleveland experiment. The superiority of demonstration is an evidence that the personal presence and activity of the teacher is an effective agency. Finally, carefully prepared oral comment by the teacher accompanying a motion picture film, contrary to the almost universal opinion of visual education specialists, adds to its effectiveness.

11. *Music, accompanying a motion picture film, appears to heighten the attention, but whether it increases the amount of information gained from it is not certain.* This question demands further investigation.

12. *There was a smaller percentage of loss on the memory tests in the case of the film groups than of the groups which were given other methods of presentation, with one exception.* The exception was the group which was shown the steamboat film, containing a large percentage of action. This group made a higher initial score than did the slide group with which it was compared. In all the other cases but one, the film groups, in which there was a smaller percentage of loss, made the lower initial scores. When the film group made a lower score than the group with which it was compared in the initial test, it also made a lower score in the final test, in spite of the fact that it suffered less loss. This was true in every individual comparison but one.

A few concluding comments may be made concerning the prevailing character of the present educational motion picture films and the direction in which they should develop in order

to be of most service to the school. The discussion deals with informational, not with dramatic films.

It is very evident from the varied proportions of educational motion picture films which are devoted to the representation of moving objects and to other types of material—still objects, charts, tables, verbal discussion—that their distinctive function has not been completely worked out. Many films attempt to do what can be done as well and more conveniently and economically in other ways. To these conclusions may be added several practical suggestions which are based upon the results of the investigation.

13. *Subject-matter should not be included in educational films which is not primarily the representation of motion or action.* Such subject-matter can be presented fully as well by the various forms of still pictures.

14. *It is uneconomical to put into motion pictures actions which can readily be demonstrated by the teacher.* In one educational film commensurate quantities are illustrated by showing the picture of a hand pouring water from a gill measure into a pint measure. It would be far better for the teacher to perform this simple act before the class and explain its significance during the performance.

15. *Motion pictures should be so designed as to furnish to the teacher otherwise inaccessible raw material of instruction, but should leave the organization of the complete teaching unit largely to the teacher.* The explanation, discussion, or elaboration of the material which is shown in the film is a function of language. Language can be used fully as effectively if not more effectively by the teacher as by the film. Furthermore, the class should take a large share in the discussion. The reduction of the motion picture to its essential core will promote both economy and flexibility.

16. *It is probably desirable to have motion picture films in small units.* The long thousand-foot units either present too much material at once, they include subject-matter not suitable

for the motion picture, or they take over the rightful function of the teacher. If smaller units are available the teacher may choose just the picture which is needed to lay the foundation for or to illustrate a particular part of the discussion.

17. *Caution should be observed to encourage initiative and an intellectually active attitude, and not to allow the use of motion pictures or other visual materials to overdevelop the attitude of passive receptivity.* The objection is sometimes made to the use of motion pictures that they will make education too easy. This objection misses the real point. If the pupil actually gets the training we wish him to secure it is no objection that he gets it easily. The real objection is that he never really completes his mastery of a subject merely from having it presented to him. He should make it a working part of his mental machinery. To provide for this we must encourage discussion, independent reading, problem and project work, and the like.

It is the opinion of the authors of this investigation that educational motion pictures have a definite and important function in education. It has been the purpose of the investigation to contribute to the definition of that function and by this means to promote their usefulness.

PART II

THE REPORTS OF THE INDIVIDUAL STUDIES

CHAPTER I

COMPARISONS OF DIFFERENT METHODS OF VISUAL INSTRUCTION

F. DEAN MCCLUSKY

The following compendium¹ summarizes the findings of fourteen experimental attempts to compare the effectiveness of various methods of visual instruction. These experiments were conducted in three different school systems, namely, the Elementary School of the University of Chicago, Chicago, Illinois, the public schools of Evanston, Illinois, and the public schools of Urbana, Illinois. The investigation began May 13, 1920, and continued until March 9, 1922.

This description of the experiments will give a concise statement of (1) the various problems which were attacked, and (2) the method by which the studies were made. This will be followed by a summary of each individual experiment, covering (1) the comparisons made, (2) the instructional materials, and the way in which they were used, and (3) the results and conclusions.

A summary of the experiments and general statement of conclusions is placed at the end of the abstract.

The writer wishes to acknowledge his indebtedness to Professor Frank N. Freeman, of the University of Chicago, for his inspiration and guidance throughout the conduct of the experiments. He is also indebted to Principal H. O. Gillet of the University Elementary School, Assistant Superintendent D. E. Walker, of Evanston, Superintendent William Harris, of Urbana, and the principals, teachers, and pupils of the school systems in which he worked for their hearty co-operation and assistance.

¹ For a detailed account see: Frederick Dean McClusky, *An Experimental Comparison of Different Methods of Visual Instruction*. A dissertation submitted to the Faculty of the Graduate School of Arts and Literature in candidacy for the degree of Doctor of Philosophy, University of Chicago, August, 1922.

The materials of visual education may be classified under three large headings, first, objects in their natural settings, second, objects taken from their natural settings, and third, objects and processes represented by means of charts, photographs, motion pictures, models, maps, stereopticon slides, stereographs, and sketches. Visual education, as commonly conceived, deals for the most part with the third group, and of that group great interest is centered in the school's use of the motion picture, slide, and stereograph. It is not surprising, then, that most of the research in visual education has concerned itself with a determination of the instructional effectiveness of the last named materials.

The field of research in visual education divides itself into five problems: first, the correlation of the materials enumerated above with the curriculum, second, the determination of the pedagogical effectiveness of the different materials, third, the study of the technique of teaching with visual aids, fourth, the improvement of the mechanics of representation, and fifth, the investigation of the administrative problems involved in handling the materials of visual education.

The problems which were attacked in the fourteen experiments can all be grouped under problems two and three listed above, namely a comparison of the relative effectiveness of the different materials and a study of (different methods of using visual aids.) An analysis of the various aspects and factors of the learning situation created and the reaction of pupils in that situation is made in a number of experiments. Minor problems which were revealed as the investigation progressed were taken up and attacked in subsequent experiments.

METHOD

I. SUBJECTS

The total number of children acting as subjects in these experiments is 649. These pupils ranged from the fourth to the eighth grades inclusive. Many of the pupils acted as subjects in three different experiments.

Comparable groups were selected for each experiment on a basis of grade, chronological age, and score made in an intelligence examination. The Illinois Intelligence Examination was used as a basis for selection in Experiments 1, 6, 7, 8, 9, 10, 11, 12, 13, and 14. The Chapman Intelligence Examination¹ was used in Experiments 2, 3, and 4. The subjects in Experiment 5 were selected at random by taking every other pupil according to the seating arrangement in the room.

These comparable groups were formed prior to the experiments and each pupil remained in his group throughout the course of the investigation in his school. It was found, however, on checking results after the experiments were finished, that absences during the investigations had operated to unbalance the groups in number, age, and intelligence. The unbalanced groups were rebuilt in order to make allowance for such differences by throwing out of the groups which had a higher number of pupils those pupils whose intelligence score and chronological age did not match very closely pupil for pupil the intelligence score and chronological age of pupils of the smallest group. This procedure formed groups equal in number and approximately equal in intelligence. Further equalization was obtained by throwing out of the groups those pupils whose intelligence scores did not match, pupil by pupil, within a difference of three points.

Experience of subjects with the visual method.—The pupils who participated in Experiment 1 had had the experience of being subjects in a trial experiment and were not totally unfamiliar with "film learning." The Evanston schools had carried on a semi-educational film program for two years up to the time of Experiments 2, 3, 4, and 5. Hence, the pupils composing the groups at Evanston were familiar with the film situation and had acquired something of the technique of gaining information from films.

The Thornburn School in Urbana owns a Keystone 600 Set and a regular program of visual instruction is carried on in

¹ J. Crosby Chapman, "A Group Intelligence Examination without Prepared Blanks," *Journal of Educational Research*, II, No. 5, 777-86.

the geography and history classes. Hence the subjects in Experiments 6, 7, 8, 9, and 10 had had experience in using slides and stereographs in the classroom prior to the studies made at Thornburn. The pupils at Leal School, Urbana, who formed the groups used in Experiments 11, 12, 13, and 14, had not had any previous experience with visual aids in the classroom except that they had participated in one preliminary experiment.

Even though the subjects were familiar with the learning situation created by using visual aids in the classroom before their participation in the experiments, the writer recognizes that it would have been desirable to have had subjects thoroughly trained in the technique of acquiring information from pictures. However, he feels justified in using pupils not so trained for three reasons: (1) subjects thoroughly trained in the technique of learning from pictures were not available, (2) at the time these experiments were undertaken no one had made any scientific attempts to determine best methods of training pupils to "learn from pictures" nor had anyone made a systematic survey of experience relating to that problem, and (3) these experiments compare the effectiveness and use of different types of visual aids, so that acquiring information from pictures was a task common to all groups participating in the experiments.

2. THE SELECTION OF SUBJECT-MATTER

Seven moving-picture films were used as instructional units, each produced by the Society for Visual Education, Incorporated, Chicago, Illinois. The films by title and classification are as follows:

Title of Film	Subject
1. <i>French Explorations in North America</i>	History
2. <i>The Life History of the Monarch Butterfly</i>	Nature Study
3. <i>The Panama Canal and Its Historical Significance</i> ..	Economic History
4. <i>Canals in United States History</i>	Economic History
5. <i>Waste Disposal in Cities</i>	Health and Sanitation
6. <i>The Story of a Mountain Glacier</i>	Physical Geography
7. <i>The Steamboat in United States History</i>	Economic History

These films, produced under the direction of educators, and illustrative of some of the traditional topics in the curriculum, afforded an excellent opportunity to compare the effectiveness of this new instructional material with other visual aids. The films were selected (1) to represent a variety of subjects in order to give breadth to the application of the results and (2) in accordance with the recommendation of members of the Society for Visual Education, in order to secure films representative of the best efforts of the society up to the time of selection.

Experiment 14 is the only one in which a film was not used as a basis for comparison. The subject-matter of the experiment was a discussion of the topic "The Middle Atlantic States" as treated in Brigham and McFarlane's *Geography*, Book II.

The subject-matter of all the instructional material other than the films was based on the content and arrangement of the films under scrutiny. The teacher who was to present the lesson by a method other than the film method was shown the film and given a copy of the syllabus of the moving-picture. The teacher then organized the oral instruction and illustrative material step by step as it was presented by the film. Even though the teacher's verbal instruction closely followed the outline of the film, the presentation was flexible enough to typify the normal classroom situation. Each lesson in an experiment occupied the same length of time.

3. DESCRIPTION OF THE TESTS USED

Two types of tests were used in Experiments 1-6 to measure the product of the various forms of instruction. These were a question test and a map or chart test. A third test was given in Experiments 8, 9, 10, 11, 13, and 14. The pupils were asked to write a free composition covering the subject of the lesson. Each type of test measured different aspects of the total product.

The question test was designed to measure the information the pupil had acquired from the presentation. It consisted of a series of questions so worded that the answers could be given in

one to five words. About one-fifth of the "questions" were sentences of the completion type. For example, in Experiments 1, 3, 6, and 10 respectively, the first two questions were:

1. French explorers sailed from —— to ——.
 2. In what kind of boats did they cross the Atlantic?
-
1. What is a larva?
 2. Where does the monarch larva get its food?
-
1. How did early settlers carry their goods and freight from one place to another?
 2. What was the trouble with this early kind of carrying things as compared to modern methods?
-
1. Where does snow accumulate?
 2. Of what are glaciers composed?

All the question tests were mimeographed with the exception of Experiment 1, where the questions were written on the blackboard. Each test was given under standard conditions. At the beginning of the test period uniform directions were given to each group. For example, in Experiment 7 the directions were:

First write your name, grade, and home teacher on every sheet you use. Then answer the questions just as rapidly and as well as you can. Put your answer in the blank spaces provided. You will all be given time to finish. When you are through with your test turn the sheet over on your desk.

The pupils were allowed to write until all had finished.

In scoring the test a correct answer key was made by the writer and his assistants, and each paper was checked against the score key. One point was given for each correct answer. In questions requiring two or more answers one point was assigned to each part of the total answer correctly given. The total score was the sum of the points.

The chart or map test was designed to measure one of the three following pupil abilities: (1) to reproduce by simple sketches objects shown during the lesson, (2) to trace sequences shown in maps or charts; and (3) to show locations on a map. These tests measured the non-language aspect of the product.

The map or chart questions were interspersed with those of the question test thus making it possible to administer the two tests simultaneously as well as adding a touch of variety to the examination. Examples of the map or chart questions used in Experiments 2, 5, 7, and 13 are given here, the number before the question indicating the number of the question in the test from which it is taken.

4. Trace on your map the first route these explorers took in reaching the Great Lakes. Number this 1. (Experiment 2)
12. Locate on your map the important portages. Mark each with an X. (Experiment 2)
12. On the back of this sheet draw a map of the Panama Canal indicating the Caribbean Sea, Panama City, Miraflores, Gatun, Culebra Cut, Chagres Lake and the Pacific Ocean. (Experiment 5)
23. Make a diagram on the back of this sheet showing how dishwater poured into the kitchen sink would go from place to place until it reaches the ocean (Boston). (Experiment 7)
13. In the space below describe the "Clermont" in detail. Draw a picture of it on the back of this sheet. (Experiment 13)

In scoring the chart or map test a correct answer key was made by the writer and his assistants, and each paper was checked against the score key. One point was given for each part of the object correctly reproduced, or place correctly located, or step in the sequence correctly shown. The total score was the sum of the points.

The composition test was designed to measure the spontaneous reaction of the pupils to the lesson. It was thought that phases not covered in the question test and the chart or map test might be measured by the compositions. The composition test preceded the question test in Experiments 8-11. It came after the question test in Experiment 7. In Experiments 13 and 14 the test was interspersed with the questions of the question test by asking the pupils to write short descriptive paragraphs. (For example, see Question 13 from Experiment 13 quoted above.) No composition test was given in Experiments 1-6 inclusive or in Experiment 9. Each test was given under standard conditions. The pupils were allowed to write until all had finished.

TABLE I

Experiment	Type of Test	Possible Score in Points	Total Possible Score in Points
1.....	{ Question test Map test	{ 13 25 }	38
2.....	{ Question test Map test	{ 13 25 }	38
3.....	{ Question test Chart test	{ 15 2 }	17
4.....	{ Question test Map test	{ 21 7 }	28
5.....	{ Question test Map test	{ 21 7 }	28
6.....	{ Question test Map test	{ 31 10 }	41
7.....	{ Question test Chart test Composition test	{ 27 35 45 }	107
8.....	{ Question test Chart test Composition test	{ 15 2 55 }	72
9.....	{ Question test Map test	{ 31 10 }	41
10.....	{ Question test Chart test Composition test	{ 27 5 64 }	96
11.....	{ Question test Chart test Composition test	{ 27 14 64 }	105
12.....	{ Question test Chart test Composition test	{ 27 5 64 }	96
13.....	{ Question test Chart test Composition test	{ 18 36 (thrown out) }	54
14.....	{ Question test Map test Composition test	{ 117 36 (thrown out) }	153

In scoring the compositions, one point was given for each thought unit correctly stated. The writer trained an assistant specially for scoring the compositions. She scored all the papers by checking them against the content of the lessons as given in stenographic reports and outlines of the instruction.

A delayed memory test exactly like the first immediate recall test was given the subjects in Experiments 6-13 inclusive. Each test was given under standard conditions. The memory tests were scored under the same conditions and by the same persons scoring the immediate recall tests.

In order to eliminate as many errors as possible all papers were scored by the writer and his assistants the first time. Later the tests were rechecked. Differences resulting from the two scorings were noted and corrections were made by the writer on a basis of the score key.

The type of test used in each experiment is listed in Table I showing the score possible in each item of the test.

4. METHODS OF SECURING RELIABLE RESULTS

Experiments duplicating each other in every respect were run in a second grade or school in all the experiments excepting 1, 6, 8, 9, 12, and 14. Of these six experiments, all were duplicated with a variation in the procedure except Experiment 14. Thus the results of the two experiments could be checked one against the other. When it was found that the same result was obtained in the second experiment that was found in the first, the experiment was considered reliable. In addition to the foregoing method the groups were rotated in order that different methods of instruction might be given to each group.

EXPERIMENT 1

TOPIC: *French Explorations in North America.*

COMPARISON MADE

Film instruction was compared with oral instruction illustrated by classroom maps.

PRESENTATION OF SUBJECT-MATTER

A five-minute preliminary discussion of French explorations was read to both groups. This served as an introduction to the topic and prepared the children for the instruction to follow. The film lesson and the oral-map lesson occupied twelve minutes respectively.

The film tells the story of the explorations made by the French in North America by tracing the routes taken by the explorers from the St. Lawrence into the heart of the continent. An animated line on a map of the Great Lakes region outlines the territory covered by the French. The difficulties encountered by the French are emphasized, and reproductions of old woodcuts are frequently shown throughout the film. Action pictures are shown of Niagara Falls, a portage, and a canoe on the upper Mississippi.

An analysis of the film shows that a large proportion of the film is devoted to still pictures, maps, and subtitles. The actual proportion of each in terms of the percentage of the total number of feet in the film is: subtitles 20.71 per cent, still pictures 9.68 per cent, action pictures 13.21 per cent, animated cartoons and maps 55.85 per cent, still cartoons and maps .55 per cent.

THE RESULTS

The results of Experiment 1 are given in Table II.

TABLE II

THE RESULTS OF EXPERIMENT I, COMPARING FILM WITH ORAL-MAP INSTRUCTION AT THE ELEMENTARY SCHOOL OF THE UNIVERSITY OF CHICAGO, MAY 13, 1921

Group	Number of Pupils	Grade	Average Intelligence Quotient	Average Score in All but Map Questions	Average Score Map Questions	Total Average Score
A. Oral-map...	12	VII and VIII	106.9	9.4	7.3	16.7
B. Film.....	16	VII and VIII	106.4	10.6	5.9	16.5

An examination of the results of this first experiment shows that the oral group made an average total score .2 point or 1.2 per cent above that of the film group. This difference is too

slight to be of much significance. However, by comparing the scores made by the two groups on the map questions a difference of 1.4 points or 23.7 per cent in favor of the oral group is found. The difference in score between the two groups on the non-map questions is 1.2 points or 12.7 per cent in favor of the film group. These results indicate that the teacher emphasized the map instruction more than the film did. However, there is an indication that the teacher presented the map work more effectively than did the film, a point substantiated in Experiment 2.

Three objections which film advocates might raise concerning the reliability of the results of Experiment 1 are: first, that the film was not the best possible film to teach this particular unit; second, that pupils were trained to learn map work more economically under ordinary classroom methods than from a film, which is relatively a new method of presenting such material to children; and third, that the test did not test all of the desirable outcomes of film instruction.

While this film is perhaps not the best of films for teaching in respect to its organization and the arrangement of subject-matter, the same thing could be said of the oral instruction which followed the outline of the film. One might also raise a counter-question, namely: Was the method of "telling" used by the teacher the best method of teaching the oral group?

In answer to the second objection it should be understood that this group of twenty-eight children had been drilled somewhat in learning from the film in connection with another film, "The Influence of the Steamboat in United States History." Furthermore, the newness of the situation would be a factor in favor of the film situation, since novelty, vividness, and rapid learning go hand in hand.

A discussion of the third objection would take us into the problem of the validity and value of information tests in all educational measurement.

Since these three objections are common to all the fourteen experiments let us not be too hasty in drawing conclusions from

these experiments without due consideration of all such criticisms of the procedure.

EXPERIMENT 2

TOPIC: The topic for Experiment 2 is the same as that selected for Experiment 1, namely, *French Explorations in North America*.

A comprehensive program of research in visual education necessitated a larger laboratory than the Elementary School of the University of Chicago. A school system where moving-picture instruction had been in operation was desirable for two reasons; first, the mechanics of running the experiments would be rendered easier; and second, the subjects would be familiar with the "film situation."

Permission was obtained from Superintendent Nichols and Assistant Superintendent Walker to continue the research in the South Evanston schools. A visual education program had been in operation in Evanston for two years, and the schools were equipped with the apparatus necessary to carry forward the research in an effective manner.

Four experiments were planned on a large scale involving three schools and 282 children. A fourth school was included in the original program, but it was found to be not equipped for daytime projection.

Inasmuch as the experiments were started near the end of the school year, it was impossible to give memory tests within the time remaining. Tests the following September were out of the question since the eighth-graders had been promoted and scattered either in the secondary schools or elsewhere.

COMPARISON MADE

Three types of instruction were compared in Experiment 2: (1) two showings of the film; (2) oral instruction supplemented by classroom maps; and (3) oral instruction combined with film instruction.

PRESENTATION OF SUBJECT-MATTER

A five-minute introduction to the topic was read to each group. The film, oral-map, and oral-film instruction each lasted

twenty-four minutes. A description of the film is given in Experiment 1.

The oral-map instruction paralleled the outline of the film. The teacher traced the routes taken by the French on a classroom map while the pupils followed the routes by referring to a map of North America in their geographies. Each pupil used the same map.

The oral-film instruction consisted, first, of a twelve-minute period during which the pupils listened while the teacher told the story of the French explorations and traced the routes taken by the French on a large classroom map. After the twelve-minute oral discussion the group was shown the film.

Experiment 2 was repeated at the Lincoln School after having been carried out at the Central School.

RESULTS

The average scores made by each group on the map test, question test, and total score is shown in Table III.

TABLE III
THE AVERAGE SCORE MADE BY EACH GROUP IN EXPERIMENT 2

GROUP	NUMBER OF PUPILS	AVERAGE INTELLIGENCE SCORE	QUESTION TEST		MAP TEST		TOTAL SCORE	
			Average Score	M.D.	Average Score	M.D.	Average	M.D.
B. Oral-film.. A. Oral-map. C. Film.....	Central School, May 23, 1921, Grades VII and VIII							
	21	53.98	10.14	1.53	8.28	4.92	18.42	5.13
	21	54.04	9.71	1.12	11.66	4.32	21.37	5.24
	21	54.10	9.19	1.78	5.47	3.83	14.66	5.01
	Lincoln School, May 24, 1921, Grades VII and VIII							
	22	60.25	9.72	1.30	12.22	3.61	21.94	4.99
	22	60.12	9.18	1.26	11.04	3.36	20.22	4.80
	22	60.18	10.63	1.37	9.63	2.28	20.26	5.04

CENTRAL SCHOOL RESULTS

The question test scores show the oral-film group to rank first, being .95 point or 10.34 per cent higher than the film group,

and the oral-map group to rank second, being .52 point or 5.66 per cent above the film group.

The map-test scores are widely separated as in Experiment 1. The oral-film group map score is 2.81 points, or 51.37 per cent higher than the film group, and the oral-map group is 6.19 points or 113.16 per cent higher than the film group.

The total scores show the oral-map group to be 2.95 points or 16.01 per cent above the oral-film group, and 6.71 points or 45.77 per cent above the film group.

LINCOLN SCHOOL RESULTS

The rank of the oral-map and oral-film groups is reversed from what it is in the Central School in the map-test and total score. The film group also changes its rank by making the highest question-test score and by making the second highest total score.

The question-test scores show the film group to be .91 point or 9.36 per cent higher than the oral-film group, and 1.45 points or 15.79 per cent higher than the oral-map group.

The map-test scores again are higher for the oral groups than for the film group. The oral-film group is 2.59 points or 26.89 per cent higher than the film group. The oral-map group also exceeded the film group by 1.41 points or 14.64 per cent.

The total score made by the oral-film group is 1.72 points or 8.5 per cent above that made by the oral-map, and 1.68 points or 8.29 per cent above that made by the film group.

If we combine the total scores for the two schools we find that the oral-map group ranks first, the oral-film group second, and the film group third with a very narrow margin between the first two and a wide margin between the oral groups and the film group.

Four points stand out of the results of Experiments 1 and 2. First, the film groups made the lowest map test score in each of the three schools. Second, the film groups made the lowest total scores in two schools and is only 0.4 point ahead of the lowest score in the third school. Third, a combination of oral instruction and film instruction proves to be much more effective than pure film instruction. Fourth, groups taught wholly or in part

by teachers rank higher than film groups in all three schools in the map test and total score, with the one exception noted above, even though five different teachers taught the five "oral" groups.

ANALYSIS OF MAP RESPONSES

Let us analyze the responses made in the map test to find wherein the film method was not successful.

In the two Evanston schools fifty-one¹ pupils received pure film instruction. Nine of these pupils misplaced St. Louis or Detroit or both on their maps, one even going so far as to place St. Louis near the St. Lawrence River. Nine pupils in the two groups mixed the routes the French followed. Two pupils started routes near the Hudson and Delaware rivers. Two traced over the boundary lines of the Great Lakes in an attempt to reproduce the routes taken by the French. Three pupils made no score on the map test. The remainder of the fifty-one pupils were correct as far as they went in the map test. The highest score made by any film group pupil on the map test was 17, out of a possible 25.

Forty-four¹ pupils in the two schools received oral instruction illustrated by a classroom map. Of these pupils, nine misplaced St. Louis, the greatest error being the placement of St. Louis at the present site of Cleveland. Others placed the city in Illinois on the Illinois River. None of the pupils traced wrong routes and all of them made points on their map test. The highest map score made by any pupil in the oral groups was 18 out of a possible 25.

Fifty-two² pupils received oral plus film instruction. Of these, three misplaced St. Louis, and one misplaced both Detroit and St. Louis. One pupil drew routes that were wrong. The highest score made was 23 out of the possible total of 25.

The foregoing analysis indicates that pure film instruction failed to fix the correct location of the various routes and settlements in the minds of the pupils. What is the explanation of

¹ This number represents the total number of pupils taking the test.

² This number represents the total number of pupils taking the test who received pure film instruction.

this failure? Is it due to the fact that the film flashed on the screen in succession a map, then a subtitle, then a picture, then the map showing the continuation of the animated line, and so on, giving the child a piecemeal picture of the entire map? Is this failure the result of poor attention during the presentation of the film? Does the film situation scatter the attention of the pupil?

A partial answer to these questions may be found in the responses to questions which were asked orally at the conclusion of the test period. For the film groups the question was: "What did you learn from the second showing of the film which you did not learn the first time?" The pupils wrote their answers in the space left at the bottom of the test sheet.

Fifty-one pupils of the two schools replied as shown in Table IV.

TABLE IV

THE RESPONSES TO QUESTION 1: "WHAT DID YOU LEARN FROM THE SECOND SHOWING OF THE FILM WHICH YOU DID NOT LEARN THE FIRST TIME?"*

Response	Number of Pupils Making Response
Hard to get all first time.....	5
Did not notice first time.....	3
Did not concentrate first time.....	1
Did not watch close first time.....	1
Saw places skipped first time.....	1
Able to give more attention to details the second time.....	10
Second time helped to remember details.....	16
Did not get small print in film at first.....	3
Moved up closer the second time.....	4
Nothing made plainer by second showing.....	5
Did not answer question.....	2

* Film groups, Central and Lincoln schools, 51 pupils.

The responses listed in Table IV show that the pupils evidently did not give 100 per cent attention to the film presentation, that some device is needed to center their attention on the important facts, that the print must be large enough to be read to the farthest corner of the ordinary classroom, and that the

film, in continuous presentation, often changes to a new scene before the pupils have a chance to grasp all in the one scene before them.

The groups which received oral-film instruction were asked the following questions:

1. What did you learn from the film that you did not learn from the teacher?
2. What did you learn from the teacher that you did not learn from the film?

The answers were written by the pupils at the bottom of the mimeographed test sheet.

TABLE V

THE RESPONSES OF PUPILS TO QUESTION 1: "WHAT DID YOU LEARN FROM THE FILM THAT YOU DID NOT LEARN FROM THE TEACHER?"

CENTRAL SCHOOL		LINCOLN SCHOOL	
Response	No. Pupils Making Response	Response	No. Pupils Making Response
Moving black line made routes more plain.....	4	Moving black line made routes more plain.....	3
Routes were made more plain by film.....	5	Routes were made more plain by film.....	8
Film was more definite.....	2	Niagara map more clear....	1
Film more interesting and distinct.....	1	Great Lakes more clear....	1
Portages and travel more clear	1	Portages more clear.....	2
Seen more plainly amount of ground covered.....	1	Clear at first, later routes were mixed up.....	1
See where trips are made after done.....	1	Drawing by Hennepin more clear.....	1
Story easier to see than to listen to on hot day.....	1	Showed side of lake they traveled on.....	1
Same as seeing it.....	1	Pictures of portages and place of portage made portages more clear.....	1
No answer to Question 1.....	9	Hardships more clear by film	1
		Film and teacher both clear	3
		Nothing made more clear by the film.....	3

The responses were tabulated by schools and by question in Tables V and VI.

The responses listed in Table V show that the animated black line attracted the attention of the pupils. However, this did not teach effectively the sort of thing called for in the test,

since these pupils were unable to reproduce the "moving black line" as accurately as those who received the oral-map instruction. One pupil said the film was more interesting and one thought it was "easier to see than to listen on a hot day."

TABLE VI

THE RESPONSES OF PUPILS TO QUESTION 2: "WHAT DID YOU LEARN FROM THE TEACHER THAT YOU DID NOT LEARN FROM THE FILM?"

CENTRAL SCHOOL		LINCOLN SCHOOL	
Response	No. Pupils Making Response	Response	No. Pupils Making Response
Teacher talked as she pointed to map.....	5	Teacher talked as she pointed to map.....	5
Emphasis made routes clearer	3	Routes were more clear because teacher did not go so fast.....	1
Teacher went slow, emphasized routes.....	1	Film was too fast to keep your mind on story.....	1
Teacher was more plain.....	1	Everything made clearer by teacher.....	1
Teacher was clear because she was thorough.....	1	Portages and way of transportation made more clear by teacher because of reasons why, explanations, and incidents.....	8
Did not answer question.....	11	Story part clearer by teacher, made names clear.....	2
Teacher best.....	3	Courage and hardships.....	1
Clear by teacher, did not understand parts of film...	1	Both clear.....	3
		No answer.....	4

A number of the responses listed in Table VI are very interesting in view of the questions listed above. Ten of the fifty-two pupils said the routes were made more clear by the teacher *because she talked while pointing to the map*. Three pupils said the film was too fast and eight said the teacher made the portages more clear because she told incidents connected with the story and reasons for making the portages.

One must not be hasty in drawing conclusions from answers which are the opinion of the subjects involved in the experiments.

However, they at least furnish some valuable leads for future experiments controlled in such fashion that the problems raised above can be solved in the scientific manner.

EXPERIMENT 3

TOPIC: *The Life History of the Monarch Butterfly.*

COMPARISONS MADE

Experiment 3 compares the efficiency of the film in teaching the information contained in a unit of natural history with (1) a stereopticon lecture and (2) an oral presentation illustrated by two still pictures and two blackboard sketches.

PRESENTATION OF SUBJECT-MATTER

The oral instruction followed the outline of the film. The topic was illustrated with two pictures, one of the butterfly, the other of the larva taken from the book entitled, *Ways of the Six-footed* (pp. 48, 50).¹ The teacher also drew pictures of the chrysalis and spicules on the blackboard.

The stereopticon lecture followed the outline of the film. The slides, eight in number, were loaned to the writer by Mr. R. E. Wager, then of the School of Education of the University of Chicago. They illustrated every step in the life-cycle of the monarch.

The presentation of the stereopticon lecture at the Central School was disturbed by parents visiting the school that afternoon. The slide group's attention to the lecture was visibly diverted to the noise made by the visitors.

The film instruction consisted in one showing of the film. The film sketched in picture form the life-cycle of the butterfly, starting with the larva feeding on the milkweed and carrying the story forward step by step until the butterfly breaks out of the chrysalis and climbs on a leaf to dry its wings.

The length of each period of instruction was twelve minutes.

¹ Anna Botsford Comstock, *Ways of the Six-footed*. Boston: Ginn & Co., 1903.

RESULTS

The results obtained in Experiment 3 are shown in Table VII.

TABLE VII

THE RESULTS OF EXPERIMENT 3 WITH THE FILM, "THE LIFE HISTORY OF THE MONARCH BUTTERFLY," AS CONDUCTED AT EVANSTON

GROUP	No. PUPILS	AVERAGE INTELLIGENCE SCORE	TOTAL SCORE		TOTAL SCORE
			Average	M.D.	Median
C. Oral..... B. Stereopticon..... A. Film..... C. Oral..... B. Stereopticon..... A. Film.....	Central School, May 30, 1921. Grades VI and VIII				
	21	53.95	12.23	2.08	12.87
	21	53.95	13.14	1.61	14.49
	21	53.90	13.47	1.88	14.12
	Lincoln School, May 31, 1921. Grades VII and VIII				
	20	60.60	14.65	1.38	15.00
	20	60.55	13.90	1.31	15.00
	20	60.65	13.55	1.26	14.20

CENTRAL SCHOOL RESULTS

An examination of the scores in Table VII shows that the film group made the best score of the three groups, being .33 point or 2.51 per cent above the average of the slide group, and 1.24 points or 10.13 per cent above the average of the oral group. However, if the median scores are compared, one finds that the slide group is .37 point or 2.62 per cent above the film group, which is in turn 1.25 point or 9.71 per cent above the oral group.

In comparing the scores made by the slide group with the other scores we must take into consideration the fact that during the presentation of the stereopticon lecture there was considerable confusion in the hall where the experiments were being conducted. The disturbance was so great that seventeen of the twenty-one pupils wrote on their papers that they could not hear all that was said on account of the noise in the hall. This statement was made in answer to the question, "Was there

anything about the story of the *Life History of the Monarch Butterfly* that you did not understand?"

LINCOLN SCHOOL RESULTS

The results in the Lincoln School do not check with the results obtained at the Central School. Two factors may explain this discrepancy. First, no confusion occurred during the stereopticon lecture at the Lincoln School. Second, different teachers taught the oral groups.

By average scores the oral group was superior to the slide group .75 point or 5.39 per cent. The slide group in turn made a better score than the film group by .35 point or 2.58 per cent. By median scores the oral and slide groups are tied at 15 points for the highest score which is .80 point or 5.62 per cent higher than the film group.

The results of this experiment are either so contradictory in the two schools or so close together that the most significant fact seems to be that the stereopticon group made a slightly higher median score than the film group in both schools. This difference in favor of the stereopticon group might have been more marked in the Central School had the stereopticon lecture gone through undisturbed.

An analysis of the film in terms of the footage devoted to subtitles, action pictures, and still pictures gives the following results: subtitles 23.18 per cent, still pictures 18.03 per cent, and action pictures 58.79 per cent. If we contrast the results of Experiments 1 and 2 with Experiment 3 we find the butterfly film made a better showing in Experiment 3 than French explorations did in Experiments 1 and 2. This indicates that the *Life History of the Monarch Butterfly* is better adapted to classroom instruction than *French Explorations in North America*. We would certainly expect a film made up of 58.79 per cent of action pictures, action which is fundamental to a complete understanding of the action of the larva and the way in which the butterfly breaks out of the chrysalis, to make a more creditable showing in the classroom than a film made up mostly of maps and woodcuts.

EXPERIMENT 4

TOPIC: *The Panama Canal and Its Historical Significance.*

COMPARISONS MADE

Three forms of presentation are compared in Experiment 4, (1) two showings of a film, (2) a stereopticon lecture plus one projection of the film, and (3) an essay read to the pupils plus one projection of the moving-picture.

PRESENTATION OF SUBJECT-MATTER

The essay read to the oral-film groups was the one accompanying the syllabus of the film sent out by the Society for Visual Education. It took fifteen minutes to read the essay. While the sketch provided a background for the film it did not duplicate the outline of the film. Hence, some of the information gained by the pupils from the essay could not be used in answering the questions in the test.

Following the essay the oral-film groups received fifteen minutes instruction from one presentation of the film.

Twenty-five picked slides were rented from the McIntosh Slide Company, Chicago, for the stereopticon lecture. The lecture followed the outline of the film and attempted to duplicate the film as closely as possible. The writer attempted to have slides made direct from the film for use in Experiment 4 but was not successful in obtaining permission from the Society for Visual Education to duplicate the film in slides.

Following the stereopticon lecture the slide-film group received fifteen minutes film instruction.

The film instruction consisted of two showings of the film, each projection consuming fifteen minutes.

RESULTS

The average scores made by the six groups in the twofold test are shown in Table VIII.

The low total scores made by the oral-film group in both schools is of little comparative significance since the essay proved to be above the comprehension of the pupils. This shows, how-

ever, that the printed material accompanying a film should be carefully correlated with the film itself if it is to serve the purpose of providing a background for the film.

TABLE VIII

THE AVERAGE SCORES MADE BY THE SIX GROUPS IN EXPERIMENT 4

GROUP	NO. OF PUPILS	AVERAGE INTELLIGENCE SCORE	MAP SCORE		TOTAL SCORE	
			Average	M.D.	Average	M.D.
C. Oral-film..... B. Slide-film.... A. Film..... A. Oral-film..... C. Slide-film.... B. Film.....	Central School, June 3, 1921. Grades VII and VIII					
	21	52.14*	.38	.61	8.47	2.95
	21	54.90	1.76	.60	12.71	4.47
	21	54.86	1.33	1.45	13.66	3.35
	Lincoln School, June 4, 1921. Grades VII and VIII					
	20	62.60	.95	1.11	10.75	3.60
	20	62.20	2.80	.94	16.45	2.89
	20	62.30	1.00	1.38	13.20	2.48

* It was found impossible to match the intelligence-test scores of all the pupils in this group with pupils in the other groups without reducing the number of pupils.

The oral-film group received one-half as much instruction on the map work as the other two groups, hence, a comparison between the map scores made by the oral-film group and the other groups would not be legitimate. Let us consider, then, only those scores made by the film and slide-film groups.

CENTRAL SCHOOL RESULTS

The slide-film group at the Central School made a lower total score than the film group, a difference of .95 point or 7.47 per cent. The film group made a score .43 point or 3.23 per cent lower on the map question than the slide-film group. (Since the total possible score on the map question was 7 points, this difference of .41 or 3.2 per cent is of greater significance than appears at first glance.)

LINCOLN SCHOOL RESULTS

At the Lincoln School the slide-film group made a total average score of 3.25 points or 24.61 per cent above that of the

film group and 1.80 points or 180 per cent above that of the film group on the map question. Here again, as in Experiments 1 and 2, we find pure film instruction is not as effective in teaching map work as some combination of oral and visual material.

ANALYSES OF MAP RESPONSES

In order to make a detailed study of the maps of the Canal Zone drawn by the pupils,¹ they were classified under three distinct types. Type 1 is a map which includes the Isthmus of Panama and in most cases the lower and upper portions of North America and South America respectively. The canal is indicated by a line or double line. The locations called for in the question are indicated by dots or lines drawn to that part of the canal by the pupil. (For the sample maps see Figs. 1 and 3-6.) Type 2 is a map drawn from the impression made on the subjects by the film close-up map of the Panama Canal Zone. This map is a black and white flat map. (See Fig. 2.) The white lines outline the canal. The canal is represented by a line running across the close-up map in the same manner as recorded in sample map A, Type 2. The lines which resemble the boundaries of fields in sample map B, Type 2, represent the boundaries of the Central American states shown in another map by the film. Hence, sample map B, Type 2, represents a confusion of the Canal Zone map and the Central American states map shown by the film.

Type 3 is a map used in the stereopticon lecture. This map is a relief map in a rectangular frame and is reproduced in sample A, Type 3.

A study of these reproductions shows that the pupils remembered lines but not locations in the film maps. (See sample B, Type 2.) No Type 2 maps were scored as high as sample A. Sample B is typical of the Type 2 responses.

The film groups saw only the film map, hence we find their responses to belong to either Type 1 or Type 2. The slide-film groups saw both maps, the slide map *first*. Table IX shows

¹ The map-test question was: "12. On the back of this sheet draw a map of the Panama Canal indicating the Caribbean Sea, Panama City, Miraflores, Gatun, Culebra Cut, Chagres Lake and the Pacific Ocean."

that even though the slide-film pupils had seen the film map nearest to the test in point of time they preferred to reproduce the slide map (Type 3).

TABLE IX

THE NUMBER OF MAPS DRAWN BY EACH GROUP
CLASSIFIED ACCORDING TO TYPES 1, 2, 3
(EXPERIMENT 4)

GROUP	NUMBER RESPONSES		
	Type 1	Type 2	Type 3
Central School			
Slide-film.....	5	2	6
Film.....	9	12	0
Lincoln School			
Slide-film.....	7	1	14
Film.....	11	4	0

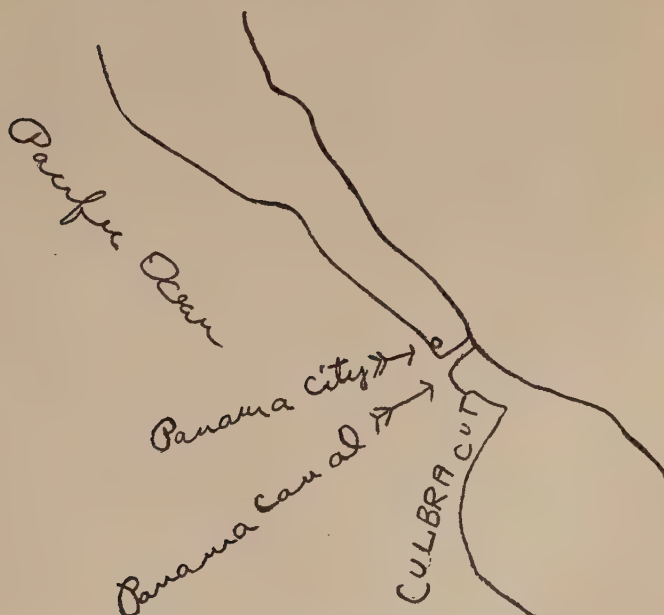


FIG. 1.—Type 1, map of the Panama Canal, slide-film group

EXPERIMENT 5

TOPIC: *The Panama Canal and Its Historical Significance.*

COMPARISON MADE

The purpose of Experiment 5 was to make a direct comparison between the information gained from one showing of a moving-

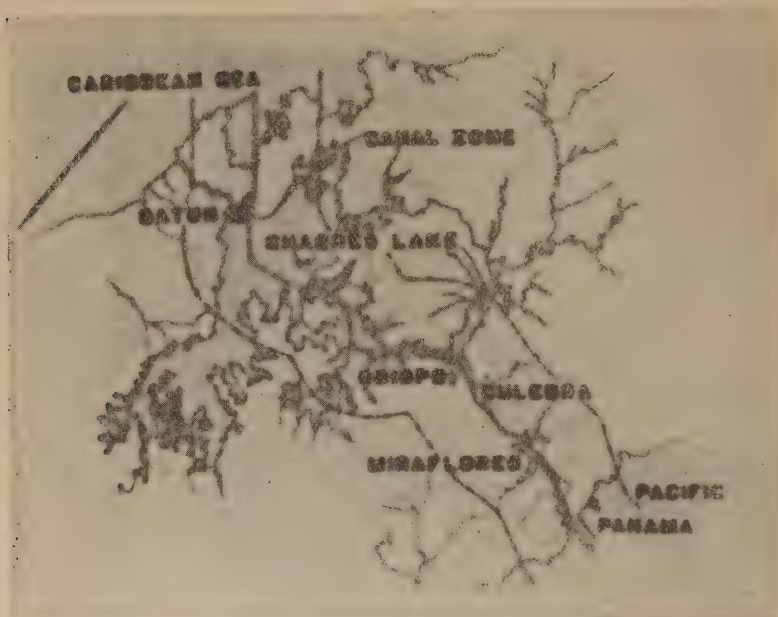


FIG. 2.—Enlarged reproduction of film maps of which the Type 2 maps are the reproduction.

picture film and the information gained from a stereopticon lecture covering the same topic.

PRESENTATION OF SUBJECT-MATTER

The period of instruction was divided into two phases. First the pupils listened to a five-minute essay on the Panama Canal made up of parts of the material read to the oral-film groups in Experiment 4. Then the film group was shown the moving-picture used in Experiment 4 and the slide group heard the stereopticon lecture used in Experiment 4.

RESULTS

The results of Experiment 5 are shown in Table X.

The average total score made by the sixty-three pupils who saw the stereopticon slides and heard the lecture was 1.87 above the average score made by the fifty-eight pupils who saw the film. This is a much larger difference than appears on the surface, since the percentage of superiority of the slide group was 62.42. In comparing the map scores we find the slide group made an average score over three times as great as that made by the film group, 309 per cent to be exact. An examination of

TABLE X

THE SCORES MADE IN EXPERIMENT 5 BY GROUPS D AND E,
WASHINGTON SCHOOL

GRADE	GROUP D. STEREOPTICON			GRADE	GROUP E. FILM		
	No. Pupils	Average Total Score	Average Map Score		No. Pupils	Average Total Score	Average Map Score
IV.....	17	1.29	0	IV.....	15	1.13	0
V.....	15	3.66	.8	V.....	19	2.73	.22
VI.....	15	7.60	.93	VI.....	9	4.63	.27
VII.....	16	7.12	1.18	VII.....	14	4.00	.50
Entire group	63	4.85	.71	Entire group	58	2.98	.23

scores by grades shows that the slide group made a higher average score in each grade than the film group, with the exception of Grade IV, where neither group was able to do anything with the map question.

The results of Experiment 5 show that the stereopticon lecture was more effective than the film in teaching the information concerning the Panama Canal called for in the test.

Again, in this experiment we find that the slide is more effective than the film in presenting this particular type of map material. By grouping the maps drawn by the film group according to the classification used in Experiment 4, we find fourteen Type 2 maps and twelve Type 1 maps. None of the fourteen Type 2 maps are more accurate or superior to sample B,

Type 2, shown in Figure 3. The difficulty which the pupils in Experiments 4 and 5 encountered in learning the locations on the film close-up map of the Panama Canal Zone shows that either the map itself is inferior for teaching these locations or that the film method is at fault.

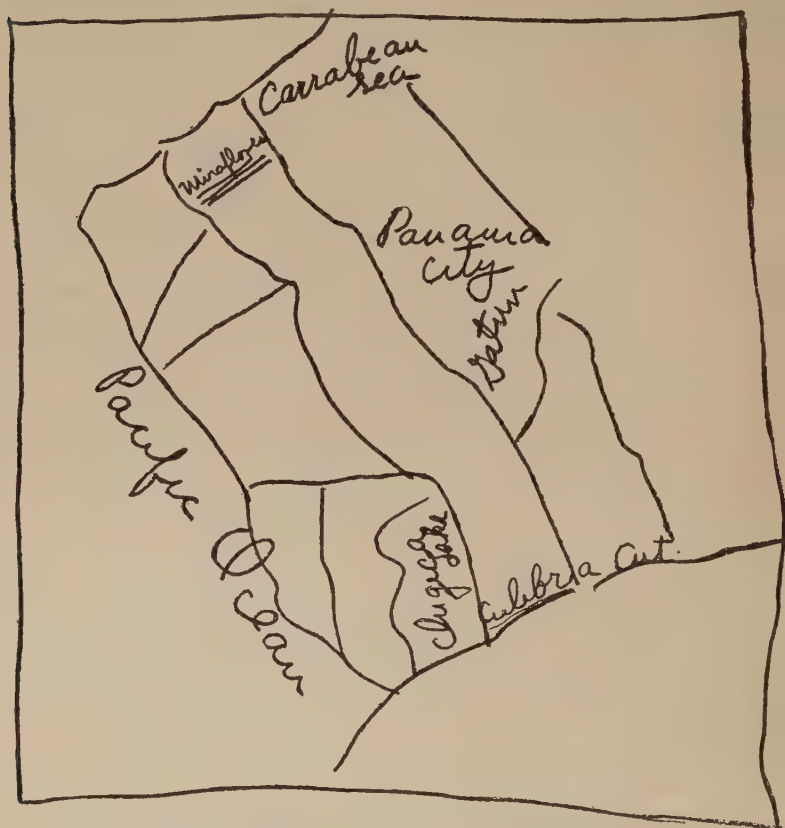


FIG. 3.—Type 2, map of the Panama Canal, film—film group, Sample B

EXPERIMENT 6

THE URBANA EXPERIMENTS

The close of the school year concluded the research at Evans-
ton with five experiments completed. However, new plans for

the opening of school in September were formulated and the experiments were pushed forward on a more comprehensive basis.

The base of operations was shifted from Evanston to Urbana, Illinois, on account of the writer's change of residence. Through the efforts of Dean C. E. Chadsey, of the College of Education of

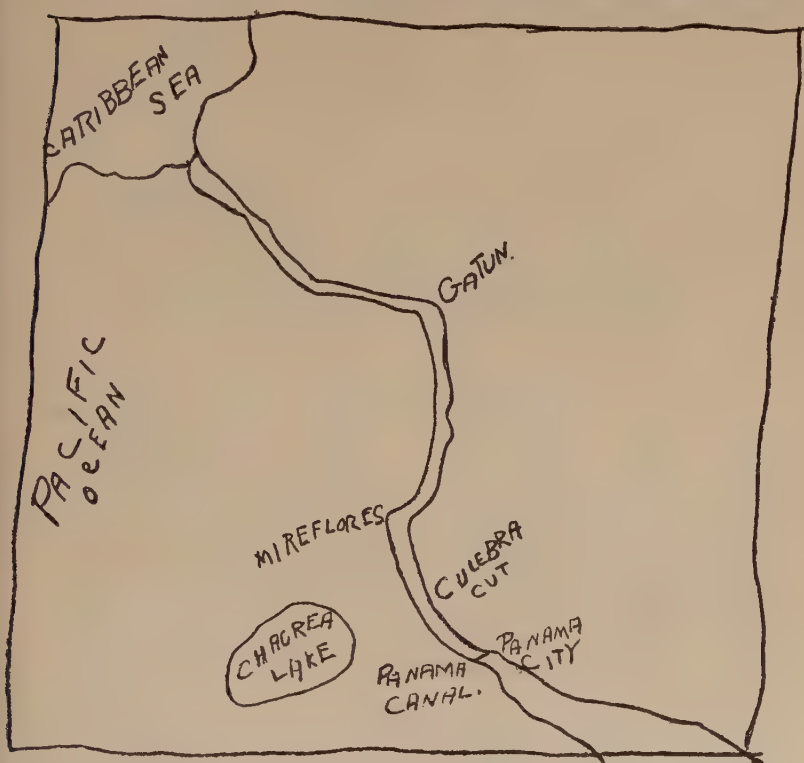


FIG. 4.—Type 2, map of the Panama Canal, film—film group, Sample A

the University of Illinois, permission was given the writer by Superintendent W. Harris to use the pupils and equipment of the Leal and Thornburn public schools for experimental purposes.

On the receipt of each film, the writer carefully timed the film subtitle by subtitle and scene by scene with a stop watch while it ran at a speed set for each film. The films were of different lengths and this fact is reflected in the different lengths

of time devoted to the presentation periods. However, the speed set for a given film was not necessarily the speed set for another. Hence, some films were projected at a slightly slower rate than others. This fluctuation in the rate of projection from film to film was purely arbitrary, but the rate of projection for any given film was fixed and strictly adhered to by the operator.



FIG. 5.—Type 3, map of the Panama Canal, slide-film group, Sample A

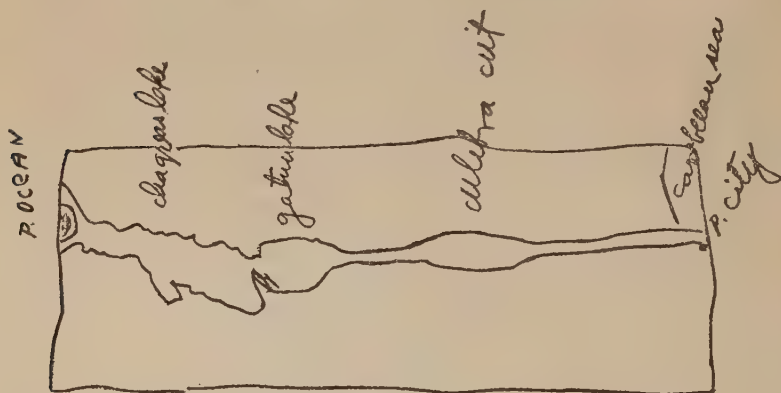


FIG. 6.—Type 3, map of the Panama Canal, slide-film group, Sample B

The proportion of time spent on different items by the film was thus accurately determined and the oral instruction guided accordingly.

TOPIC: *Canals in United States History.*

COMPARISONS MADE

The purpose of the experiment was to show the relationship between information gained from (a) two showings of a moving-

picture film and (b) one showing of the same film during which oral explanations were given. The oral explanation was given partly while the film was running and partly while it was stopped at each scene. The experiment, then, attempted to answer the question whether or not it is more effective to stop a film and talk about it during the course of its presentation than to let it run straight through without comment or stop. The use of the American projector made it possible to stop the film.

PRESENTATION OF SUBJECT-MATTER

The film groups were exposed to two showings of the film, each projection occupying fourteen minutes. The film-talk groups were shown the film for twenty-eight minutes. The film was stopped during each scene and at the "tables" at which time the writer explained the significance of the material at hand.

RESULTS

The results obtained from Experiment 6 are shown in Table XI.

An examination of Table XI shows that the film-talk group made a higher score than the film group on the question test, map test, and total score in the seventh grade. This situation is reversed in the eighth grade. However, the difference between the groups in the seventh grade is greater than the difference between the eighth-grade groups.

The seventh-grade film-talk group made a score over twice as high as the film group in the map test. The two eighth-grade groups made the same score in the map test.

The results of the original test in Experiment 6 at least show that the method of talking either while the film was running or while it was stopped was a big advantage to the seventh-grade pupils and not so great a disadvantage to the eighth-grade pupils.

RESULTS FROM THE MEMORY TEST

The memory test scores show that the seventh-grade pupils retained more of the material than the eighth-grade pupils. The percentage of loss was slightly greater in the film-talk

TABLE XI

THE RESULTS OF EXPERIMENT 6, GIVING THE ORIGINAL TEST SCORES AND THE PERCENTAGE OF LOSS BY EACH GROUP IN THE MEMORY TEST (THORNBURN SCHOOL)

ORIGINAL TEST, NOVEMBER 29, 1921

Group	Grade	No. Pupils	Average Chronological Age in Years	Average Intelligence Test Score	Average Intelligence Quotient	Average Score Questions	M.D.	Average Score Map	M.D.	Average Total Score	M.D.
A. Film.....	VII	25	13.29	78.56	101.5	13.96	2.44	.61	.62	14.57	2.69
B. Film-talk.....	VII	25	12.97	78.56	105.08	15.76	3.69	1.52	1.06	17.28	4.39
A. Film.....	VIII	34	13.87	92.89	108.06	15.61	4.06	.76	.72	16.37	4.65
B. Film-talk.....	VIII	34	14.23	92.87	106.7	14.94	4.21	.76	.81	15.70	4.51

MEMORY TEST (THREE WEEKS), DECEMBER 20, 1921

Group	Grade	No. Pupils	Average Chronological Age in Years	Average Intelligence Test Score	Average Intelligence Quotient	Average Score Questions	Percent-age Loss	M.D.	Average Score Map	Percent-age Loss	M.D.	Average Total Score	Percent-age Loss	M.D.
A. Film.....	VII	25	13.29	78.56	101.5	11.28	20	2.93	1.08	77*	1.12	12.36	16	2.64
B. Film-talk.....	VII	25	12.97	78.56	105.08	12.56	21	3.33	1.52	0	1.02	14.08	19	3.96
A. Film.....	VIII	34	13.87	92.89	108.06	12.17	23	3.94	.67	12	.78	12.84	22	4.15
B. Film-talk.....	VIII	34	14.23	92.87	106.7	11.32	25	3.91	.56	27	.76	11.88	25	4.25

* Percentage of gain.

groups than in the film groups. The seventh-grade film group gained 77 per cent in the map test, and the film-talk group made the same average score in the delayed recall map test that it made in the first test. The map-test scores are so small that little weight can be attached to the results obtained therein.

The differences in percentages of loss between the groups would indicate that the introduction of oral material lessened the permanency of the impression.

A careful analysis of the answers failed to reveal any data of importance.

EXPERIMENT 7

TOPIC: *Waste Disposal in Cities.*

COMPARISON MADE

The accumulation of data from the first six experiments gave evidence that the film was not as effective as a combination of visual aids with oral instruction in teaching locations and sequences on *maps*. Experiment 7 was organized for the purpose of showing whether or not a single projection of film containing *animated charts* would be more effective than oral instruction supplemented by the same charts in teaching the information contained in the unit of subject-matter.

PRESENTATION OF SUBJECT-MATTER

A short sketch in letter form of waste disposal in cities was read to the pupils before each instruction period to place them in a receptive mood for the topic.

The film instruction consisted in exposing the pupils to one projection of the film. The oral-chart presentation duplicated the outline of the film closely. Five charts were used to illustrate the processes of waste disposal.

These charts were copied from the film by projecting a frame of the film on to a large sheet of cardboard 24×30 inches, on which the writer traced the chart or diagram.

The writer lectured to the class for twelve minutes, referring to the charts at the points in his lecture where it was necessary. The outline of the lecture following the film by subtitles is given below.

WASTE DISPOSAL IN CITIES

(Film subtitles italicized)

A. *Waste Comes from the House.*

Refer children to typical house by illustration.

B. *From the Sink, Washbowl, Water-Closet, Bathtub, Refrigerator, and Wash-tub.*

Refer children to Chart 1.

C. *It Flows to the Street Sewer.*

Illustrate by calling attention of pupils to streets outside windows where the sewer pipes run under ground. Also refer to Chart 2.

D. *From Street Sewers to Collecting Sewer.*

Call attention of children to fact that the small sewers empty into a large main sewer running down the main street in a city. Refer to Charts 2 and 3.

E. *Boston Sewage Is Collected in Tanks at Moon Island.*

Point out to children the fact that cities on sea coast can collect the sewage in large tanks by the sea or ocean, tanks larger than the classroom or building.

F. . . . and Stored until the Tide Goes Out When It Is Discharged.

Explain briefly the actions of the tide and how gates in the tanks can open when the tide goes out taking the sewage with it far out to sea.

G. *The City of Brockton Is Not near the Water.*

Cities and towns which, like Urbana, are not near a large river, lake, or ocean must use some other means of waste disposal.

H. *Its Sewage, Therefore, Must First Flow Down to a Pumping Station.*

Explain how sewage comes from house through street sewer to collecting sewer to pumping station.

I. *Electric Pumps Send It Three Miles Beyond the City to a Purification Plant. . . .*

Ask the pupils how many have seen electric pumps (show of hands). Describe their action and size.

J. . . . through a Great Pipe.

Illustrate size of pipe by holding hand from floor. Pipe runs on top of the ground, or may run under the ground.

K. *There It Is Sprayed on a Trickling Filter.*

Describe same and refer to Chart 4.

L. *The Rocks Are Covered with a Layer of Bacteria which Purify the Sewage by Converting the Harmful Organic Matter into Harmless Minerals.*

Ask the children if they know what bacteria are (show of hands). Explain. Show that rocks are size of fist or double fist and look brown or black with a glistening coat of jelly-like substance full of bacteria.

M. *Then the Solids "Settle Out" in a Big Tank.*

Refer to Chart 4.

N. *Then the Sewage Flows upon Sand Beds.*

The one-acre beds are described. Refer to Chart 4.

O. *The Sand Grains Too Accumulate a Coating of Bacteria.*

Explain that the same process goes on in the sand beds as in the rock beds. Refer to Chart 4.

(Note that the next four subtitles and pictures in the film were not shown the film group and this material was not touched upon in the lecture.)

P. *The Process You Have Just Seen Will Now Be Reviewed and Explained by a Diagram.*

Refer to Charts 3 and 4 briefly. (NOTE.—Film spent two minutes on this review by charts. Lecture took one-half minute to allow for reference to Chart 4 in M, N, O, Q, and R.)

Q. *It Is Clear but Contains Some Dissolved Material.*

Refer to Chart 4.

R. *The Drains Flow into a Little Brook.*

Refer to Chart 4.

S. *Where the Drains Come in There Are Many Bacteria to Feed upon the Nearly Purified Sewage.*

Explain that process goes on in brooks. Bacteria drawn on board.

T. *Below This Point There Are Single-Celled Animals to Eat the Bacteria.*

Refer to Chart 5, left half.

U. *Farther Down Are "Water Fleas" which Feed on These.*

Refer to Chart 5, right side.

V. *Still Farther Down the Stream Are Minnows to Eat the "Water Fleas."*

Explain and continue story.

W. *Frogs and Tad Poles.*

X. *The Biggest Catch Was a Trout.*

Y. *And a Few Miles Below Purification Is Complete.*

Conclusion of story.

This outline of the lecture was fashioned after the film outline to make the two methods of instruction parallel each other as closely as possible. The film was timed subtitle by subtitle and scene by scene with a stop watch in order to determine the exact amount of emphasis which should be placed on each item.

The list of questions used in the question test and chart test is reproduced here in order that the reader can follow the discussion of results intelligently.

a) THE QUESTION TEST

1. From what places in the house does the waste come?
2. Where does it flow to from the house?
3. Where does it go to next?
4. Boston sewage is collected in —— at Moon Island.
5. When is this collected sewage discharged?
6. How does the city of Brockton differ from Boston?
7. Where must the sewage of the city of Brockton first flow to?
8. By what means is the sewage of the city of Brockton sent away?
9. Where is this sewage sent to?
10. There it is sprayed upon a ——.
11. How is the harmful organic matter converted into harmless minerals?
12. How do the rocks which are covered with these organisms look?
13. Where do the solids settle out?
14. Then the sewage flows upon ——.
15. What happens here?
16. How does the sewage look when it leaves here?
17. What does it still contain?
18. The sewage finally flows into a ——.
19. Here it is further purified by ——.
20. These are —— by single celled animals.
21. What feed on these?
22. These in turn are eaten by —— which the boy catches.

b) CHART TEST

23. Make a diagram on the back of this sheet showing how dishwater poured into the kitchen sink would go from place to place until it reaches the ocean (Boston).
24. Show in another diagram how waste coming from an inland city would go until it reaches its destination.

RESULTS

Experiment 7 proved to be the most satisfactory, from the standpoint of its administration, of the experiments discussed to this point. The interest of the pupils in the topic was also very keen, and the chart test called for a complete reproduction of the two methods of waste disposal in such form that the drawings could be easily analyzed and scored. The results obtained in Experiment 7 are shown in Table XII.

TABLE XII

THE RESULTS OF EXPERIMENT 7 GIVING THE ORIGINAL AND MEMORY-TEST SCORES AND PERCENTAGE OF LOSS FOR EACH GROUP (THORNBURN SCHOOL)

ORIGINAL TEST, NOVEMBER 30, 1921

Group	Grade	Pupils	Average Chronological Age	Average Intelligence Test Score	Average Intelligence Quotient	Average Score Questions	M.D.	Average Score Chart	M.D.	Average Score Composition	M.D.	Average Score Total	M.D.
C. Film...	VII	25	13.13	82.87	103.04	15.32	2.10	10.56		15.96	8.92	41.84	7.83
D. Oral...	VII	25	13.15	82.57	106.28	16.40	4.14	12.56		16.48	5.42	45.44	7.04
C. Film...	VIII	35	13.70	93.40	100.0	16.34	3.36	11.89		21.17	4.70	49.40	8.14
D. Oral...	VIII	35	13.78	93.05	108.5	17.37	2.63	15.42		25.11	4.39	57.90	7.51

MEMORY TEST (THREE WEEKS), DECEMBER 21, 1921

Group	Grade	Pupils	Average Chronological Age	Average Intelligence Test Score	Average Intelligence Quotient	Average Score Questions	Percent-age Loss	M.D.	Average Score Test	Percent-age Loss	M.D.	Average Score Composition	M.D.	Average Score Total	M.D.
C. Film...	VII	25	13.13	82.87	103.4	14.64	5	3.39	9.88	7	5.64	.....	.....	24.52	8.01
D. Oral...	VII	25	13.15	82.57	106.28	14.48	12	4.91	11.32	10	5.41	.....	.....	25.80	6.15
C. Film...	VIII	35	13.70	93.40	100.0	14.17	14	3.24	8.71	26	4.92	.....	.....	22.88	6.21
D. Oral...	VIII	35	13.78	93.05	108.5	14.85	16	2.90	12.89	17	4.30	.....	.....	27.74	7.32

RESULTS FROM THE FIRST TEST

A comparison of the average scores for each group in the original test shows that the oral-chart group, D, was superior in each item of the threefold test, this relationship holding for each grade. The seventh-grade oral-chart group was even slightly superior to the eighth-grade film group in both the question and chart tests.

A more detailed study of Table XII shows the seventh-grade oral-chart group, D, to be higher than the film group, C, by 1.08 points, or 7.0 per cent, in the question test, by 2.00 points, or 19.0 per cent, in the chart test, by .52 points, or 3.2 per cent, in the composition test, and by 3.60 points, or 8.6 per cent, in the total score. The eighth-grade oral-chart group, D, likewise is higher than the film group, C, by 1.03 points, or 6.3 per cent, in the question test, by 3.53 points, or 29.6 per cent, in the chart test, by 3.94 points or 18.6 per cent, in the composition test, and by 8.50 points, or 17.2 per cent, in the total score.

The most significant difference is manifest between the chart scores made by the two groups. The seventh-grade oral-chart group made a score 19 per cent higher, and the eighth-grade oral-chart group made a score 29 per cent higher than the film group.

RESULTS FROM THE DELAYED RECALL TEST

Seventh grade.—The memory test scores show the percentage of loss in the film group to be lower than that in the oral-chart group for both the question and chart test. The residual score made by the film group in the question test is higher than that of the oral-chart group; in the chart test the reverse is true.

Eighth-grade results.—The percentage of loss in the film group is lower than that in the oral-chart group for the question test. This result checks with the seventh grade. The film group shows a higher percentage of loss than the oral-chart group in the chart test, which is the reverse of the result obtained in the seventh grade.

The residual score made by the oral-chart group in the question test and chart test is higher than that made by the film

group, which is the reverse of the situation in the seventh grade in the former test and checks with the seventh-grade results in the latter test.

The data from the memory test indicates that the film groups were able to recall more of the information necessary to answer the question test, and that the oral-chart groups were able to retain more of the information required by the chart tests. However, in both instances conflicting results appear which minimize the importance of conclusions which might be based on the returns.

RESULTS OBTAINED FROM TESTING AN UNINSTRUCTED GROUP

Ten pupils were selected at random from the seventh and eighth grades and were given the question and chart tests used in Experiment 7. These pupils had received no direct instruction on the topic. The average score made by the group in each item of the test is as shown in Table XIII.

TABLE XIII
THE SCORES MADE BY THE UNINSTRUCTED
GROUP OF TEN PUPILS IN
GRADES VII AND VIII

Average chronological age.....	13.40
Average intelligence test score.....	87.89
Average intelligence quotient.....	106.30
Average score, question test.....	1.30
Average score, chart test.....	.40

We find that the average score made by the uninstructed group in the question test is .80 per cent of the average score made by all the pupils taking the test in Experiment 7. In the chart test the score made by the uninstructed group is .3 per cent of the average score made by all pupils taking the test. These data indicate that the tests used in Experiment 7 measured information which was without the experience of the pupils who had not received direct instruction on the topic of waste disposal in cities.

ANALYSIS OF THE ANSWERS TO THE TESTS

The data obtained from the first test show that the film failed to teach the information about waste disposal in cities as

well as the oral-chart method did. An analysis of the responses was made in order to locate if possible the cause of the failure of the film method and the points wherein the oral-chart method proved to be superior.

ANALYSIS OF THE CHART TEST

A detailed study of the responses to the chart test was made by classifying the types of error manifest in each drawing. It was found that all the errors made in answer to Question 23, tracing the Boston scheme of waste disposal, could be classified under seven headings. The errors made in answer to Question 24, tracing the Brockton scheme of waste disposal, were found to distribute themselves under ten headings. These types of errors are described in the following paragraphs. Drawings illustrative of the various types of errors are reproduced on Figures 7-12.

Boston Scheme

Question 23. Make a diagram on the back of this sheet showing how dish water poured into the kitchen sink would go from place to place until it reaches the ocean.

DESCRIPTION OF ERRORS MADE BY PUPILS ANSWERING QUESTION 23

Type 1. Pupil omitted part of sequential items. See sample A. For example, the pump is omitted at the purification station. (NOTE.—Every pupil in the experiment omitted part of each diagram hence all papers will be classified under Type 1.)

Type 2. Pupil showed Chart 1 only, viz., the house and house sewer to street sewer. Chart 1 in the film was an architect's drawing of a house, which is reproduced in sample A.

Type 3. Pupil's diagram omitted tank at Moon Island. See sample C.

Type 4. Pupil's diagram was disconnected. That is, the pupil traced the sequence through to one point, then started the sequence at another point leaving a space between the parts of the diagram on the sheet. See sample D.

Type 5. Part of the Brockton scheme was inserted in the sequence. No sample shown, but is reverse of sample E, Type *h*.

Type 6. The diagram consisted of a mixture of hit-and-miss lines, meaning nothing.

Type 7. Pupil's drawing consisted of a line crooked at places and labeled sink, house sewer, and so on. See sample F.

Brockton Scheme

Question 24. Show in another diagram how waste coming from an inland city home would go until it reaches its destination.

DESCRIPTION OF ERRORS MADE IN RESPONSE TO QUESTION 24

(Types are designated *a*, *b*, *c*, etc., to avoid confusion with Boston scheme.)

Type a. Pupil omitted part of sequential items. See sample B. For example, the unicellular animals, minnows, and fish are omitted in the response to Question 24. (NOTE.—Every pupil in the experiment omitted part of each diagram, hence all papers will be classified under Type *a*.)

Type b. The pupil interchanged the sequence of items. See sample F. Sand beds are placed before the rock beds.

Type c. The pupil's diagram started with the collecting sewer, omitting Chart 1.

Type d. The pupil's diagram started with the pump house, omitting Chart 1.

Type e. The pupil omitted pump house on to the end of Chart 4.

Type f. The pupil omitted pump house to sand bed inclusive.

Type g. Pupil's diagram was disconnected. (Same as Type 4 above.) See sample D.

Type h. Part of the Boston scheme was inserted in the sequence. See sample E. The tanks at Moon Island are inserted in the Brockton scheme.

Type i. The diagram consisting of a mixture of hit-or-miss lines, meaning nothing.

Type j. The pupil's drawing consisted of line crooked at places and labeled sink, house sewer, and so on. (Same as Type 7.) See sample F.

The following diagrams are illustrative of the types of errors classified above. These diagrams were traced from the original responses of the students and represent as nearly as possible the typical response in that classification (see Figs. 7-13).

Sample A, Type 1, represents the diagram drawn by a pupil in the eighth-grade film group. Sample B, Type 1, represents the best diagram drawn by a pupil in the eighth-grade oral-chart group. These are submitted in order that the reader may observe and compare the grade of work done by the best pupils

of the two groups. Samples A and B show both the Boston and Brockton schemes. The figure in the circles represent the score assigned that diagram.

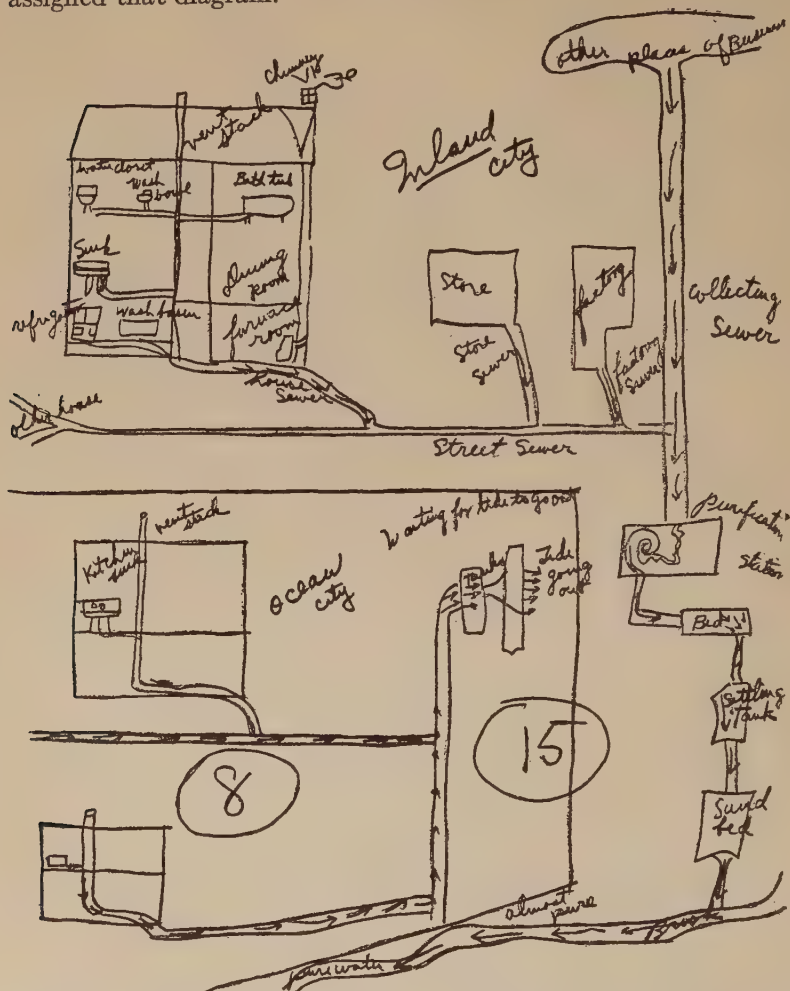


FIG. 7.—Type 1 (above) and Type a (below) Sample A, Group C (film), Grade VIII.

Table XIV shows the diagrams which can be enumerated under each classification of errors made in response to Question 23.

Table XV shows the responses which can be enumerated under each classification of errors made in response to Question 24.

TABLE XIV

THE CLASSIFICATION OF RESPONSES TO QUESTION 23, ENUMERATED
ACCORDING TO THE TYPES LISTED ON PAGE 122

Group	Grade	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Blank— No Re- sponse
C. Film.....	VII	25	3	4	1	1	1	0	3
D. Oral-chart..	VII	25	0	13	0	0	1	0	1
C. Film.....	VIII	34	4	10	1	4	0	4	2
D. Oral-chart..	VIII	34	0	23	0	0	0	0	0

An examination of each type listed above reveals the fact that these classifications can be grouped under four larger headings. First, there are errors of major omission and transposition of items in the sequence. Types 2, 3, *b*, *c*, *d*, *e*, fall into this

TABLE XV

THE CLASSIFICATION OF RESPONSES TO QUESTION 24 ENUMERATED
ACCORDING TO THE TYPES OF ERROR LISTED ON PAGE 123

Group	Grade	Type <i>a</i>	Type <i>b</i>	Type <i>c</i>	Type <i>d</i>	Type <i>e</i>	Type <i>f</i>	Type <i>g</i>	Type <i>h</i>	Type <i>i</i>	Type <i>j</i>	Blank—No Response
C. Film.....	VII	25	4	0	1	0	5	3	3	0	0	6
D. Oral-chart....	VII	25	2	2	4	5	0	0	0	0	0	4
C. Film.....	VIII	34	2	0	3	1	0	4	6	2	4	5
D. Oral-chart....	VIII	34	1	4	2	1	0	1	0	1	0	3

larger classification, and for descriptive purposes these errors will be called "sequential errors." Second, there are errors of broken sequence or disconnected responses. Types 4, 5, 6, *g*, *h*, and *i* fall into this larger classification and will be termed "disconnected errors." The third includes Types 7 and *j*, and under the fourth larger classification we will enumerate the blank papers turned in, in each group.

The same relationship holds in the eighth grade, the ratio being thirty-one for the oral-chart group to twenty for the film group out of sixty-eight diagrams submitted (see Table XVI).

By combining the number of sequential errors by group and grade we find that the oral-chart groups submitted fifty-seven and the film groups submitted thirty-seven papers containing such errors. Further study of these sequential errors shows that

TABLE XVI

THE CLASSIFICATION OF THE RESPONSES TO QUESTIONS 23 AND 24 ENUMERATED ACCORDING TO "SEQUENTIAL ERRORS," "DISCONNECTED ERRORS," TYPES *7* AND *j*, "BLANKS"*

Group	Grade	Sequen- tial Errors	Discon- nected Errors	Types <i>7</i> and <i>j</i>	Blank Papers
C. Film.....	VII	17	12	0	9
D. Oral-chart.....	VII	26	1	0	5
C. Film.....	VIII	20	17	8	7
D. Oral-chart.....	VIII	31	2	0	3

* The words "sequential" and "disconnected" are used here to describe the errors which represent the reaction to the film situation in terms of the film's presentation. For example, the film presents subtitles, then pictures, then subtitles, then a chart, then subtitles, then a continuation of the chart or another picture or another chart, and so on to the end of the film. Now the charts, pictures, and subtitles, when viewed in succession, tell a story step by step which is supposed to be understood step by step in the sequence of the film. However, it was found that pupils remembered the separate scenes as units in and of themselves and failed to connect these separate scenes together in the sequence, thus making "disconnected errors" or they connected up the scenes in the two different methods of waste disposal by interchanging scenes from one method to the other, thus making "disconnected errors" representative of a confusion of the two methods. On the other hand, pupils were able to reproduce the sequences shown by the film for each method of waste disposal but omitted items in that sequence or transposed scenes within the sequence thus making "sequential errors."

thirty-six of the fifty-seven, and fourteen of the thirty-seven, papers are so placed because of the omission of the tanks at Moon Island (see Table XIV, Type 3).

The action pictures showing the tide taking the Boston sewage out to sea from the tanks at Moon Island are among the best in the film, illustrative of a process in which motion is an essential part of the concept. It is to be expected that the oral-chart method would fail to describe such a process effectively to pupils living in Urbana, Illinois. However, even the film

failed to get the concept across to fourteen of the fifty-nine pupils in the film groups.

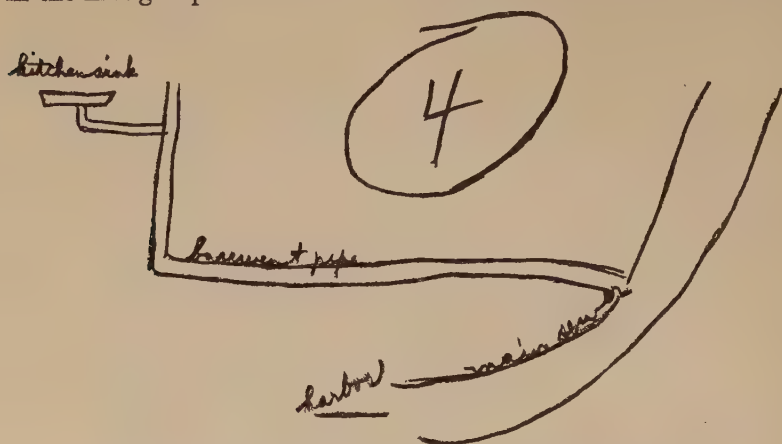


FIG. 9.—Type 3, Group D (oral-chart), eighth grade, Sample C

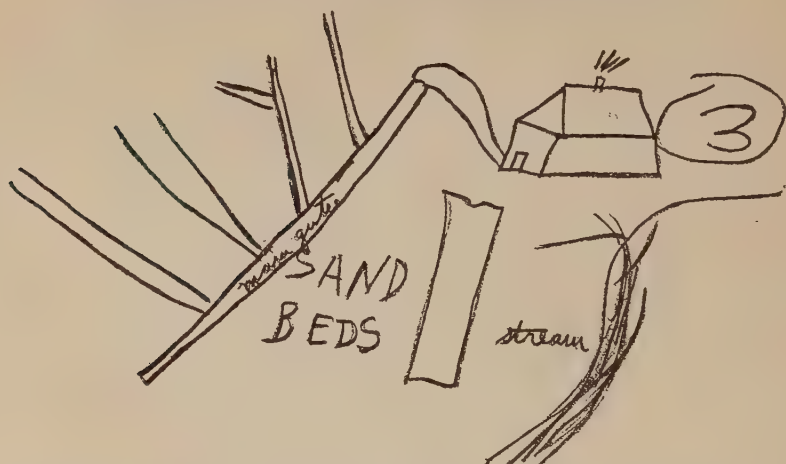


FIG. 10.—Type 4, Type g, by Hubert Rena, Group C (film), seventh grade, Sample D.

The “sequential” errors represent a lack of completeness in the diagrams, whereas the diagrams listed under “disconnected errors” are not only incomplete but lack unity of sequence and

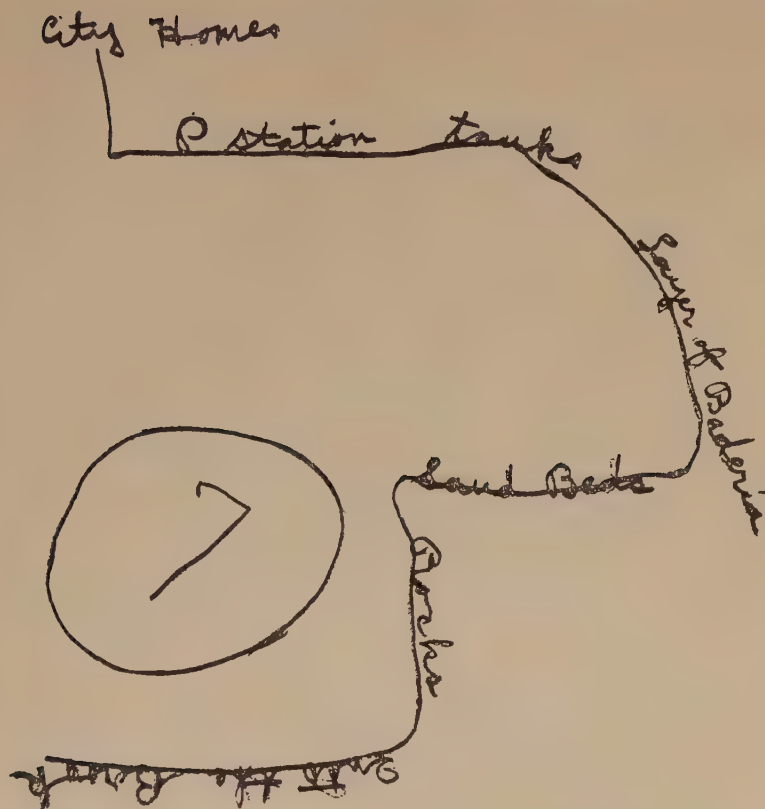


FIG. 11.—Type 7, Type *b*, Type *j*, by Dorothy Fletcher, Group C (film), eighth grade, Sample F.

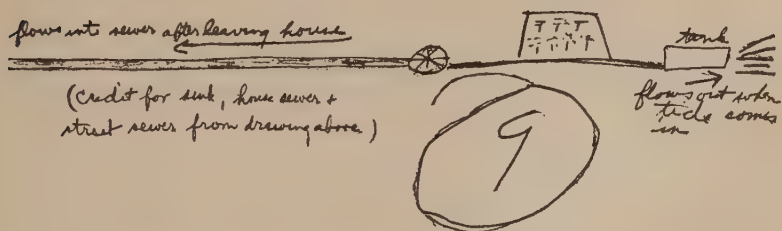


FIG. 12.—Type *h*, Group C (film), eighth grade, Sample E

represent a mixed conception of the two methods of waste disposal as well. That is, the "disconnected errors" reflect the failure of the two teaching methods to organize in the minds of the pupils the steps in the two methods of waste disposals.

Table XVI shows that the seventh-grade film group turned in twelve papers containing disconnected errors while there was only one such paper in the oral-chart group. In the eighth grade, seventeen of the film-group diagrams contained disconnected errors as contrasted with two such errors from the oral-chart group. In other words, 24.58 per cent of the diagrams turned in by the two film groups contained disconnected errors while 2.54 per cent of the diagrams from the oral-chart groups revealed similar errors. (NOTE.—In figuring these percentages, blank papers were counted as diagrams.)

These figures indicate that the film method failed to organize in the mind of the child the information it contained as well as the teacher-chart method did. This result is similar to the results obtained from a study of the map responses in Experiments 1, 2, 4, and 5.

The classification in Table XVI shows eight drawings in the eighth-grade film group which were of the "crooked-line type." These were the only diagrams of that type found. In the two film groups sixteen papers were turned in with nothing on them, while eight of the oral-chart group papers were blank, a ratio of two to one.

ANALYSIS OF QUESTION TEST RESPONSES

The number of correct answers to Questions 1-22 inclusive were tabulated by groups for each grade. Table XVII shows the number of accepted answers per question, per group, per grade. By calculating the algebraic differences between the number of accepted responses made by the two groups in each grade, and comparing these differences grade for grade, we find that the film group surpassed the oral-chart group in each grade in Questions 8, 14, and 20, and that the oral-chart group surpassed the film group in each grade in Questions 3, 10, 11, 12 and 16.

The film was more successful than the oral-chart method in teaching the information necessary to answer correctly the following questions:

8. By what means is the sewage of the city of Brockton sent away?

Accepted answers: by machinery, or pumps or large pipes.

14. Then the sewage flows upon ———.

Accepted answer: sand beds.

20. These are ——— by single-celled animals.

Accepted answer: eaten.

TABLE XVII

THE NUMBER OF ACCEPTED RESPONSES PER QUESTION MADE BY EACH GROUP

No. OF QUESTION	GRADE VII			GRADE VIII		
	D. Oral-Chart	C. Film	Algebraic Differences between Groups (D-C)	D. Oral-Chart	C. Film	Algebraic Differences between Groups (D-C)
1.....	105	83	-22	120	130	+10
2.....	22	23	+1	34	32	-2
3.....	22	20	-2	33	26	-7
4.....	13	14	+1	26	25	-1
5.....	13	15	+2	20	18	-2
6.....	16	16	0	22	24	+2
7.....	16	11	-5	19	20	+1
8.....	12	16	+4	23	26	+3
9.....	10	9	-1	12	21	+9
10.....	18	9	-9	31	20	-11
11.....	18	5	-13	21	7	-14
12.....	6	5	-1	20	5	-15
13.....	9	10	+1	18	13	-5
14.....	14	17	+3	23	29	+6
15.....	12	12	0	13	18	+5
16.....	18	15	-3	32	27	-5
17.....	14	16	+2	31	22	-9
18.....	15	20	+5	30	26	-4
19.....	15	4	-11	9	10	+1
20.....	12	13	+1	22	25	+3
21.....	18	17	-1	17	20	+3
22.....	22	23	+1	32	28	-4

The oral-chart method was more successful than the film in teaching the information necessary to answer correctly the following questions:

3. Where does it go next?

Accepted answer: to street sewer.

10. There it is sprayed upon a ———.

Accepted answer: rock bed or crushed rock bed.

11. How is the harmful organic matter converted into harmless minerals?

Accepted answer: by bacteria, by the action of bacteria, or bacteria feed on it.

12. How do the rocks which are covered with these organisms look?

Accepted answer: brown and slimy, or black and dirty, or a coating of jelly-like substance.

16. How does the sewage look when it leaves here.

Accepted answer: clear or like pure water.

The incorrect responses made by each group in answering the foregoing questions were listed and compared. It was found that the errors made by both groups in answering Questions 8, 14, and 20, wherein the film excelled, were of the same general type.

A comparison of the errors made by both groups in answering the five questions wherein the oral-chart method excelled indicates wherein the film failed to teach that particular information.

In Question 3, two responses in the eighth-grade film group and four in the seventh-grade film group reflect the lack of a unified or connected understanding of the steps in the Boston scheme of purification, these responses being mixed with the Brockton scheme. The following eighth-grade response is a typical example: "It goes to the Boston sewage two miles away." (No mention is made of distance in the instruction covering the Boston scheme while the Brockton sewage is pumped "three miles beyond the city to a purification plant.") None of the erroneous oral-chart responses show the same lack of connected understanding of the process.

In the answers to Question 10 the errors were largely mistakes in sequence. One pupil in the eighth-grade oral-chart group confused the Boston and Brockton methods. However, a comparison of the erroneous answers given by pupils in the film groups, with the picture on which the question was based, indicates the source of trouble for those pupils, the list of errors by groups being as follows.

ERRORS MADE BY GROUP C, FILM (EIGHTH GRADE)

1. River
2. Lake or ocean
3. Blank (4)
4. Field
5. Rocky sand
6. Low piece of ground
7. Sand purifier
8. Sand bed (2)
9. Field of sand
10. A layer or filter



FIG. 13.—The rock bed

Compare responses 1, 4, 5, 6, 8, and 9 of the eighth grade and 1, 2, 3, 5, and 6 of the seventh grade with this picture. Where are the "rocks" in the picture? This is the film picture on which the pupils based their answers. Obviously their interpretation of the picture was not as erroneous as would appear at first glance. The picture gave the wrong impression.

ERRORS MADE BY GROUP C, FILM (SEVENTH GRADE)

1. Sand bar
2. Sand bed (7)
3. Sand bank and in a river
4. Blank (3)
5. Sand bank
6. Clod field
7. Trickling sewer.

ERRORS MADE BY GROUP D, ORAL-CHART (EIGHTH GRADE)

1. Through tiles to stream
2. Rock bed at Boston
3. Screen near the power wheel

ERRORS MADE BY GROUP D, ORAL-CHART (SEVENTH GRADE)

1. Blank (5)
2. Sand bed
3. Lawn and into another pipe

Response 2, eighth-grade oral-chart group, is confused with the Boston scheme. The remainder are errors similar to those in the film group. Forty-nine of the oral-chart groups wrote acceptable answers to this question as compared to twenty-nine in the film groups.

The film group responses not accepted as answers to Question 11 show in every case that the process by which harmful organic matter is converted into harmless minerals was not clearly understood. The pupils were unable to grasp the importance of the bacterial action as presented by the film, even though the film stressed this point, going so far as to show microscopic slides of bacteria. Twenty-three per cent of the pupils in the film groups did not even attempt to answer the question. Some of the typical erroneous responses picked at random from the list follow: "By spraying"; "Rock beds"; "Sand beds"; "Long distance flowing in creek"; "It is run through a sort of machine"; "By testing"; "It collects upon this dirt"; "By being sprayed on rocks and they stick to the rocks"; and so on.

Thirty-nine pupils of the oral-chart groups wrote acceptable answers to Question 11 as compared to twelve of the film groups. The erroneous answers turned in by the oral-chart groups were of the same type as those made by the film groups.

The errors made by pupils in answering Question 12 make an interesting study. The film showed a close-up picture of a man holding one of the rocks while he scraped the slimy, dirty layer of bacteria off it. The rock looked black in the picture, like a piece of coal, but the fact that the layer of bacteria on the rock was a necessary part of the process of purification failed to go

across to the pupils. Only 17 per cent of the film groups wrote acceptable answers as compared to 44 per cent in the oral-chart groups. Thirty per cent of the film group did not even attempt to answer the question.

Twenty-two of the incorrect responses by the film groups to Question 12 were descriptive terms which would apply to any dark rock about the size of your fist, such as, "rough," "pointed," "irregular," "black," "coal," "blackspots," "dirty," and so on.

The incorrect responses of the oral-chart groups to Question 12 were either descriptive of any dark-colored stone about the size of your fist, or were mixed up with a description of the sprays and the bacteria. Forty-four per cent of the oral-chart group wrote acceptable answers. Twenty-seven per cent did not attempt to answer the question.

These rocks were described in the lecture as being about the size of your fist and covered with a brownish-black, slimy, or jelly-like substance.

The oral-chart groups made eight more correct responses to Question 16 than did the film groups. Only one pupil in the oral-chart groups failed to attempt any answer, while eight pupils in the film groups did not answer the question. Four of the nine incorrect responses turned in by the film groups described the sewage, flowing out of the pipe from the sand beds into the brook, as covered with foam. The picture in the film showed the water to be clear and clean. The foam was caused by the air bubbles which formed when the water from the pipe splashed into the stream.

The producer of the film made a special effort at this point to show the effect of the entire process of purification on the appearance of the sewage as it left the sand beds, yet four pupils were more impressed by the "foam" on the sewage than the fact that it was clear and clean. A word of explanation by a teacher given at this point during the showing of the film would have corrected the mistaken interpretation of the picture.

The foregoing analysis of errors reveals many limitations of this film as a teaching unit in and of itself. These limitations

will be discussed in the conclusions. The analysis was not carried into the memory tests since it would prove to be largely a repetition of the material above. However, a study of the memory tests would be valuable in showing what particular information proved to be the most permanent as a result of the different forms of presentation.

EXPERIMENT 8

TOPIC: The topic selected for Experiment 8 was the same as that used in Experiment 3, namely, *The Life History of the Monarch Butterfly*.

COMPARISONS MADE

Comparisons were made between three forms of instruction, first, one projection of the film; second, an oral lecture illustrated by pictures copied from the film; and third, one showing of the film accompanied by oral explanation during the projection of the film on the screen.

PRESENTATION OF SUBJECT-MATTER

A three-minute discussion of the life-history of the Monarch butterfly was read to each group. This discussion prepared the pupils for the more detailed instruction to follow.

The oral-chart instruction consisted in an informal talk illustrated by six charts copied from the film. The talk lasted twelve minutes.

The film instruction consisted in one showing of the film which lasted twelve minutes.

The film-talk instruction consisted of one showing of the film accompanied by oral explanations. The oral discussion was given while the film was running. The presentation lasted twelve minutes.

RESULTS

The average scores made by each group in Experiment 8 are shown in Table XVIII.

RESULTS FROM THE ORIGINAL TESTS

The rank of the three groups in the question test is, first the film-talk group, A, second the oral-chart group, C, and third

TABLE XVIII

THE SCORES MADE BY THE PUPILS IN EXPERIMENT 8 ON THE ORIGINAL TESTS AND THE MEMORY TEST

ORIGINAL TEST, DECEMBER 6, 1921

Group	Grade	No. Pupils	Average Chronological Age in Years	Average Intelligence Test Score	Average Intelligence Quotient	Average Question Score	M.D.	Composition Score	M.D.	Average Total Score	M.D.
A. Film and talk...	VIII	30	13.80	92.28	108.5	12.13	1.74	20.80	3.81	32.93	4.20
C. Oral-chart....	VIII	30	13.51	92.12	110.20	10.57	2.43	21.57	5.94	32.13	7.68
D. Film.....	VIII	30	13.71	92.28	107.9	10.40	1.99	16.43	4.67	26.83	6.00

MEMORY TEST, FEBRUARY 20, 1922

Group	Grade	No. Pupils	Average Chronological Age in Years	Average Intelligence Test Score	Average Intelligence Quotient	Average Question Score	Percent-age Loss	M.D.	Composition Score	Percent-age Loss	M.D.	Average Total Score	Percent-age Loss	M.D.
A. Film and talk...	VIII	30	13.80	92.28	108.5	5.50	55	2.63	6.40	70	2.89	11.90	64	4.54
C. Oral-chart....	VIII	30	13.51	92.12	110.20	4.30	60	2.72	4.93	77	2.97	9.02	72	5.00
D. Film.....	VIII	30	13.71	92.28	107.9	3.10	71	2.13	5.50	67	2.53	8.60	68	4.16

the film group, D. The film-talk group was 14 per cent higher than the oral-chart group and 16 per cent higher than the film group. (In Experiment 7, Group D was the oral-chart group which made an average score much higher than the film group C. The personnel of these groups was the same in both experiments with the exception of four pupils who were absent from each group. Group A was the film group in Experiment 6 which made a slightly higher score than the film-talk group B, which was not used in Experiment 8.)

The rank of the three groups in the composition test is, first the oral-chart group C, second the film-talk group A, and third the film group D. The oral-chart group is 31 per cent higher and the film-talk group is 26 per cent higher than the film group.

In the total score the film-talk group is 2.4 per cent higher than the oral-chart group which is in turn 19 per cent higher than the film group.

In each of the three scores we find that the film-talk group made an average score higher than the film group. This result is contrary to the statement commonly made by film enthusiasts, that it is psychologically wrong to talk to a group while a film is being shown.

We also find that the film-talk group is higher than the oral-chart group in the question test and total score. This difference indicates the advantage of the film itself over the black and white charts or pictures copied from the film for purposes of illustration.

RESULTS OBTAINED FROM THE DELAYED RECALL TESTS

The residual score made by the three groups in the question test rank the film-talk group first, the oral-chart group second, and the film group third. The same relationship holds for the three groups in the residual total score.

The composition test residual score made by the film-talk group is 16 per cent higher than that made by the film group which in turn is 11 per cent higher than the oral-chart group. This result is worthy of special note in view of the large difference between the film group and the other two groups in the original test.

The memory-test scores indicate a distinct advantage for the film-talk method over the other two methods as far as the amount retained is concerned.

The percentage of loss for each group varies in each of the three tests. In the question-test score the film group has the highest percentage of loss, with the oral group second, and the film-talk group third. The highest percentage of loss in the composition-test score is shown by the oral-chart group, with the film-talk group second, and the film group third. The highest percentage of loss in the total score is likewise found in the oral-chart group, with the film group second, and the film-talk group third. In none of the three scores does the oral-chart group show the lowest percentage of loss. A group which had been taught by the film recorded the lowest percentage of loss in each instance. Hence, the group receiving the largest amount of oral instruction shows the greatest percentage of loss, taking the experiment as a whole. A similar result was obtained in Experiment 7.

In order to check the validity of the tests in terms of the information possessed by the pupils previous to the experiment, thirty-seven pupils of the eighth-grade group, B, were given the twofold test at the same time the memory test was given to Groups A, C, and D. These papers were scored along with the memory-test papers. The results are shown in Table XIX.

TABLE XIX

THE RESULTS OF GIVING THE "BUTTERFLY TEST" TO
THIRTY-SEVEN UNINSTRUCTED EIGHTH-GRADE
PUPILS

Average question score	.64
Average composition score	1.73
Average total score	2.37
Average intelligence score	92.51
Average intelligence quotient	107.60
Average age	14.10

By finding the percentage each score in Table XIX is of the average question, composition, and total original scores for the three groups, we have the percentage of each score which can be

attributed to previous knowledge. Thus we find that 5.5 per cent of the original question score, 3.2 per cent of the original composition score, and 2 per cent of the total score may be attributed to knowledge of the life-history of the Monarch butterfly which the pupils possessed previous to Experiment 8.

EXPERIMENT 9

TOPIC: *Canals in United States History*

COMPARISONS MADE

The purpose of Experiment 9 was to compare the amount of information gained from a single showing of a film with the information gained from a film presentation accompanied by oral explanation during the projection. This comparison is the same as the one made in Experiment 8.

PRESENTATION OF SUBJECT-MATTER

An essay introductory to the topic was read each group to prepare them for the more detailed instruction to follow.

The film instruction consisted in a single showing of the film, which took fourteen minutes.

The film-talk instruction consisted in a projection of the film, during which oral explanations of the film were given to the groups. The period of instruction was fourteen minutes in length.

RESULTS

The results of this experiment are shown in Table XX.

An examination of Table XX shows that the film-talk group, D, made a score on each item of the test higher than the film group, C. This result is the same as that reported in Experiment 8. Hence we find in two experiments making the same comparison, in two different schools, using two different films, that the same result obtains.

The film-talk group is superior to the film group by 16 per cent in the question test, by 56 per cent in the map test, and by 20 per cent in the total score.

TABLE XX
THE RESULTS OF EXPERIMENT 9 SHOWING THE AVERAGE SCORES BY THE SIXTH-GRADE GROUPS,
C AND D, LEAL SCHOOL, IN THE ORIGINAL TEST AND MEMORY TEST

ORIGINAL TEST, JANUARY 17, 1922

Group	Grade	No. of Pupils	Average Chronological Age	Average Intelligence Score	Average Intelligence Quotient	Average Question Score	M.D.	Average Map Score	M.D.	Average Total Score	M.D.
D. Film-talk.....	VI	25	11.51	68.24	106.04	9.68	2.93	1.44	1.49	11.12	4.15
C. Film.....	VI	25	11.78	68.44	106.32	8.32	3.13	.92	.96	9.24	4.83

MEMORY TEST (NINE WEEKS), MARCH 14, 1922

Group	Grade	No. of Pupils	Average Chronological Age	Average Intelligence Score	Average Intelligence Quotient	Average Question Score	M.D.	Average Map Score	M.D.	Average Total Score	M.D.
D. Film-talk.....	VI	25	11.51	68.24	106.04	6.96	2.84	1.40	1.16	3.36	3.87
C. Film.....	VI	25	11.78	68.44	106.32	6.12	2.12	1.56	1.39	7.08	4.01

* Percentage gain.

The memory test reveals the same relationship between the two groups with the exception of the map score. Here the film group records a gain of 69.56 per cent. This large percentage of gain is not significant in view of the fact that the average score made was only 1.56 points.

The percentage of loss is less for the film group than for the film-talk group in each item of the test. This result is the same as that reported in Experiment 8. While explanations given during the showing of the film seem to enable the pupils to perform better in an immediate recall information test, the film-talk group forget a larger percentage of the material thus acquired than film group. However, the residual scores for the film-talk group are higher than those made by the film group with one exception, the map score.

EXPERIMENT 10¹

TOPIC: *The Story of a Mountain Glacier.*

COMPARISONS MADE

The deeper one digs his way into a research problem, the more refined his technique of procedure becomes, and the more critical he is of his own digging. Progress seems to be increasingly slower.

The experience with the first eight experiments led the experimenter to omit no effort in his attempts to duplicate the film situation in the teacher situation as closely as possible in Experiment 10. This desire was realized in the happy selection of a film wherein a well-known geographer was shown giving an illustrated chalk talk. The writer practiced the same chalk talk, and then selected two groups from each of the seventh and eighth grades to be taught by the two methods. A comparison was made, therefore, between the amount of information taught by the film and that taught by the writer's duplicating chalk talk.

PRESENTATION OF SUBJECT-MATTER

The film instruction consisted of a thirteen-minute showing of *The Story of a Mountain Glacier*. This film is a moving-picture

¹ Experiment 10 chronologically is Experiment 9.

of Professor W. W. Atwood giving a blackboard chalk talk. The subtitles serve in lieu of the spoken word, and still scenes of a glacier are interspersed throughout the film in the capacity of additional illustrative material. One scene of floating icebergs represented the only action picture in the film outside of Professor Atwood's actions.

The writer duplicated this material by copying two charts from Professor Atwood's drawings, and by practicing the other chalk sketches until he was able to reproduce them in a fairly accurate and rapid manner. The pictorial material was illustrated and described verbally as the talk progressed. The chalk-talk instruction occupied thirteen minutes.

During the presentation, assistants sitting in front of the groups estimated from minute to minute the number of pupils *not* paying attention to the instruction. The assistants were trained for the work by the writer, who copied the method from that used by Professor H. C. Morrison, of the University of Chicago Laboratory Schools.

RESULTS

The scores made by each group in Experiment 10 were tabulated by groups and the averages recorded in Table XXI.

These averages show that the chalk-talk groups made higher scores than the film groups in each item of the original threefold test in both grades. The differences between the two seventh-grade groups in the question and chart test is very small, a difference of only .76 points or 5.9 per cent on the question test, and .03 points or 1.1 per cent on the chart test, in favor of the chalk-talk group. The chalk-talk group, seventh grade, wrote longer compositions than the film group by 9.44 ideas per composition on the average. The difference between the two groups in the total score is 10.13 points, making the total score of the chalk-talk group 34 per cent higher than the film group.

The eighth-grade film group, C, made a noticeably lower score on the tests than the chalk-talk group, D. In fact, the performance of the film group in the eighth grade is lower than

TABLE XXI

THE AVERAGE SCORES MADE BY THE GROUPS IN EXPERIMENT 10, SHOWING THE ORIGINAL TEST SCORES, THE MEMORY-TEST SCORES, AND THE PERCENTAGE OF LOSS IN THE MEMORY TEST
(THORNBURN SCHOOL)

ORIGINAL TEST, DECEMBER 13 AND 14

GROUP	GRADE	No. OF PUPILS	AVERAGE CHRONOLOGICAL AGE	AVERAGE INTELLIGENCE SCORE	AVERAGE INTELLIGENCE QUOTIENT	QUESTION SCORE		CHART SCORE		COMPOSITION SCORE		TOTAL SCORE	
						Average	M.D.	Average	M.D.	Average	M.D.	Average	M.D.
C. Chalk talk.....	VII	27	13.03	82.81	107.14	13.61	2.36	2.62	1.02	23.77	5.06	40.00	6.30
D. Film.....	VII	27	13.19	82.69	106.10	12.85	2.05	2.59	1.61	14.33	3.51	29.87	6.64
B. Chalk talk.....	VIII	35	13.00	93.71	108.70	15.71	3.00	3.57	.94	18.17	5.97	37.45	7.77
C. Film.....	VIII	35	13.80	93.84	109.50	11.80	2.89	1.70	1.25	13.90	5.15	27.40	7.90

MEMORY TEST (FIVE WEEKS), JANUARY 17 AND 18

GROUP	GRADE	No. OF PUPILS	AVERAGE CHRONOLOGICAL AGE	AVERAGE INTELLIGENCE SCORE	AVERAGE INTELLIGENCE QUOTIENT	QUESTION SCORE		CHART SCORE		COMPOSITION SCORE		TOTAL SCORE	
						Average	M.D.	Average	M.D.	Average	M.D.	Average	M.D.
C. Chalk talk.....	VII	27	13.03	82.81	107.14	11.22	1.8	1.11	.81	14.03	3.89	26.37	5.44
D. Film.....	VII	27	13.19	82.69	106.10	11.37	1.2	1.51	1.01	13.77	4	26.66	11
B. Chalk talk.....	VIII	35	13.00	93.71	108.70	12.40	2.2	1.80	1.02	12.94	29	27.14	7.00
C. Film.....	VIII	35	13.80	93.84	109.50	10.65	1.0	1.08	.86	12.40	11	24.13	9.28

either of the seventh-grade groups in each item of the threefold test. The writer is at a loss to explain this performance, since the factors throughout the administration of the test were nearly constant in each group. Nothing happened during the conduct of Experiment 10 to account for the performance of Group C which was observed by the writer or his assistants.

The scores made by Group C, eighth grade, are lower than the chalk-talk group by 3.91 points or 33.1 per cent in the question test, by 1.87 points or 110.0 per cent in the chart test, by 4.27 points or 30.7 per cent in the composition test, and by 10.05 points in the total score. The total score of the chalk-talk group is 37 per cent higher than the film group's total score. This is almost the same relationship between the total scores as was found in the seventh grade.

An examination of the scores made in the memory test shows that the residual score for the seventh-grade film group, D, is higher in each item than the chalk-talk group, C, with the exception of the composition test score.

The differences between the two groups, however, are very slight, being less than one point in each item. The percentage of loss is therefore greater for the chalk-talk group than the film group in each part of the test, the most noticeable difference in loss showing in the composition test, where the film group only recorded a loss of 4 per cent as compared to the chalk-talk group's loss of 41 per cent.

The residual score recorded by the eighth-grade groups shows the chalk-talk group to have the higher score in each item, with a total score 12 per cent higher than the film group in the question score, chart score, composition score, and total score. In Experiment 10 the film group's percentage of loss is lower than the chalk-talk group in every item of the threefold test in both grades. This result adds more weight to similar findings in Experiments 6, 7, and 8.

An un instructed group which took the threefold glacier test performed as shown in Table XXII.

On comparing the scores made by the uninstructed group with the average scores in each item of the test made by the eighth-grade groups, we find that the uninstructed group made a score 29 per cent as high as the average in the question test, 10 per cent as high as the average in the chart test, 53 per cent as high in the composition test, and a total score 39 per cent as high as the average total score.

The high score made by the uninstructed group indicates that the eighth-grade pupils had acquired some knowledge, previous to the experiment, concerning mountain glaciers from their geography classroom work. On inquiry it was found that these pupils had made a superficial study of mountain glaciers.

TABLE XXII

THE SCORES MADE BY AN UNINSTRUCTED GROUP IN
THE EIGHTH GRADE IN THE GLACIER TEST

No. of pupils	11
Average chronological age	12.85
Average score, intelligence test	93.65
Average intelligence quotient	106.40
Average question score	4.09
Average chart score	.27
Average composition score	8.50
Average total score	12.86

Another factor might explain the high score made by the uninstructed group, namely, the make-up of the test itself. A critical examination of the test questions shows that the answer to a number of the questions can be found in the question following. The assistants who made up the test failed to note that fact. The writer was unable to correct this error before the experiment since he was to give the oral instruction, and hence was not permitted to see the tests until after the close of the experiment.

An analysis of attention was made in terms of the number of pupils not paying attention to the presentation per minute. The assistant making the analysis was instructed to watch the group and record the number of pupils who were observed not paying attention. The assistant sat in front of and to one side of the group.

The method of recording the analysis was as follows: first, a line was drawn and below the line the number of pupils in the section was placed as a denominator; then the line was divided into sections representing one minute each. The lapse of time from the beginning of the period was indicated by the upper

ATTENTION ANALYSIS—EXPERIMENT 10

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'		
17	23	24	24	25	25	22	24	23	24	24	22	23	300	=82.41%
28	28	28	28	28	28	28	28	28	28	28	28	28	364	

Group C, chalk talk, seventh grade, December 14. Observer, Miss Neville.

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'		
31	29	27	31	29	28	22	31	27	28	28	31	26	362	=84.38%
33	33	33	33	33	33	33	33	33	33	33	33	33	429	

Group D, film, seventh grade, December 14. Observer, Miss Stuart.

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'		
38	39	38	39	40	38	38	30	35	34	38	40	36	483	=90.81%
41	41	41	41	41	41	41	41	41	41	41	41	41	533	

Group B, chalk talk, eighth grade, December 14. Observer, Miss Hilgard.

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'		
39	33	36	35	39	34	40	38	40	34	30	20*	36	454	=87.30%
40	40	40	40	40	40	40	40	40	40	40	40	40	520	

Group C, film, eighth grade, December 13. Observer, Miss Neville.

* Atwood's continued drawing bored the children at this point.

row of figures. The numerators immediately above the line indicate the number of pupils paying attention during the various periods. The fraction at the right is the computed total average which represents the average percentage of pupils who paid attention for the whole period.

The accuracy of this method of attention analysis is, of course, open to question. Even though a pupil may appear to be

inattentive, he may be paying strict attention, and vice versa. However, a child might be paying attention without looking at the lecturer in the oral group, but not without looking at the screen in the film group. At any rate, this method serves as a check on the attention situation which is more accurate than the opinion of the observer covering the class period as a whole.

The percentage of time during which each group was at attention during the presentation reveals that the seventh-grade groups were not as attentive to the presentation as they should have been. The attention in the film group was slightly better than in the chalk-talk group. In the eighth grade the chalk-talk group seemed to pay closer attention to the presentation than the film group.

One noticeable fact was reported by the observers of the film groups, namely, that toward the end of the subtitle or scene in the film the pupils became inattentive and restless, waiting for the next scene or subtitle to appear.

The contention held by film enthusiasts that one always secures very superior attention to the showing of a film is not upheld by the analysis reported above.

EXPERIMENT 11

An experiment which duplicated Experiment 10 in every respect was carried out at the Leal School, Urbana, on January 6, 1922. The only change in the procedure was the substitution of Miss Wiley, principal of the Leal School, for the writer in the chalk-talk instruction.

The groups were given the threefold test described in Experiment 10 plus an additional item which was added to the chart test. Each pupil was asked to draw a cross-section of a glacier.

The memory test was administered on February 17, 1922, six weeks after the original test.

RESULTS

The averages made by the groups in Experiment 11 are shown in Table XXIII.

TABLE XXIII

THE AVERAGE SCORES MADE BY THE LEAL SCHOOL GROUPS, A, B, C, AND D ON THE ORIGINAL TEST AND MEMORY TEST IN EXPERIMENT II

ORIGINAL TEST, JANUARY 6, 1922

GROUP	GRADE OF PUPILS	No. of PUPILS	AVERAGE CHRONOLOGICAL AGE	AVERAGE INTELLIGENCE SCORE	AVERAGE INTELLIGENCE QUOTIENT	QUESTION SCORE		CHART SCORE		COMPOSITION SCORE		TOTAL SCORE	
						Average	M.D.	Average	M.D.	Average	M.D.	Average	M.D.
B. Oral.....	V	26	10.44	52.81	103.15	8.15	3.18	1.60	.75	13.04	1.36	22.70	4.51
A. Film.....	V	26	10.62	53.10	103.34	6.19	3.04	1.31	1.24	13.09	3.59	21.10	6.25
D. Oral.....	VI	26	11.89	66.65	101.40	11.55	2.80	2.80	.85	16.00	3.72	30.95	5.12
C. Film.....	VI	26	11.40	66.90	106.30	8.80	2.68	1.90	.72	11.95	2.75	22.35	4.89

MEMORY TEST, FEBRUARY 17, 1922

GROUP	GRADE OF PUPILS	No. of PUPILS	AVERAGE CHRONOLOGICAL AGE	AVERAGE INTELLIGENCE SCORE	AVERAGE INTELLIGENCE QUOTIENT	QUESTION SCORE		CHART SCORE		COMPOSITION SCORE		TOTAL SCORE	
						Average	M.D.	Average	M.D.	Average	M.D.	Average	M.D.
B. Oral.....	V	26	10.44	52.81	103.15	8.04	2.40	.96	.53	10.00	2.19	19.00	4.76
A. Film.....	V	26	10.62	53.10	103.34	6.74	2.52	1.30	1.16	10.46	2.31	18.50	5.23
D. Oral.....	VI	26	11.89	66.65	101.40	10.80	1.84	1.70	.74	14.00	4.00	26.30	4.83
C. Film.....	VI	26	11.40	66.90	106.30	8.35	2.65	1.50	.68	10.15	2.80	20.00	4.74

* Percentage gain.

The average scores made by the groups in the original test in Experiment 11 show that the film group ranks below the oral-chart group in each grade in every item of the test except the composition test in the fifth grade.

The oral-chart group surpassed the film group in the sixth grade by 31.3 per cent in the question test, by 47.3 per cent in the chart test, by 42.5 per cent in the composition test, and by 38.2 per cent on the total score.

In the fifth grade the oral-chart group surpassed the film group by 31.6 per cent in the question test, by 2.2 per cent on the chart test, and by 7.5 per cent on the total score. The fifth-grade film group was able to produce .65 ideas on the average more than the oral-chart group, a difference of .5 per cent.

In general these results are the same as those reported in Experiment 10. The factor which was not the same in the two experiments was the introduction of a different teacher into Experiment 11 for the oral instruction, which only serves to establish the superiority of the teacher situation on a more solid foundation.

The memory-test scores show the oral-chart group to be higher than the film group in the residual scores in the question, map, composition tests, and total scores, in the sixth grade. On the other hand, the residual scores made by the film group in the fifth grade are higher than the oral group in the chart and composition score.

The percentage of loss made by the film group in the sixth grade is lower than the oral-chart group in the question, chart, composition tests, and total scores. In the fifth grade the film group recorded a gain of 8.8 per cent on the question score and a loss of only .8 per cent on the chart score. The oral-chart group lost 40 per cent on the chart score and 16.7 per cent on the total score. The percentage of loss in every item of the test in both grades was less for the film group except in the fifth-grade composition score, which showed a loss .2 per cent lower for the oral-chart group.

It would appear that regardless of the length of the period between the original test and memory test the groups which received pure film instruction retain more of what they learn than the groups which were exposed to oral-chart instruction.

The attention analysis made by the writer's assistants during the two presentation periods shows that the attention in the film group was .54 per cent better than in the oral group which is so small in amount as to be without significance.

The attention analysis which was made by the two assistants follows.

ATTENTION ANALYSIS—EXPERIMENT 11

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	
66	65	63	64	65	63	65	62	63	63	64	65	63	831
66	66	66	66	66	66	66	66	66	66	66	66	66	858
													=96.85%

Group B and D, oral, fifth and sixth grades, Leal School, January 6, 1922.

Observer, Miss Stuart

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	
67	67	67	66	67	67	67	65	66	67	67	60	68	861
68	68	68	68	68	68	68	68	68	68	68	68	68	884
													=97.39%

Group A and C, film, fifth and sixth grades, Leal School, January 6, 1922.

Observer, Miss Neville

NOTE.—The groups were together for the oral and film presentations; hence the large number of pupils in each section. The total number of pupils in attendance at the presentation is given.

EXPERIMENT 12

TOPIC: *The Story of a Mountain Glacier.*

COMPARISON MADE

One of the major types of visual aids is the stereograph. Experiments 1-11 have dealt only with the film, the slide, the wall map, the blackboard sketch, and the chart. It was decided to organize Experiment 12 to compare three different methods

of instruction; first, a stereopticon lecture; second, a discussion supplemented by stereographs; and, third, a film presentation.

PRESENTATION OF SUBJECT-MATTER

The film instruction consisted of a single projection of the film, taking thirteen minutes. See Experiment 10 for a description of the film.

Two charts copied from the film, and one blackboard sketch, prepared by the writer before each period of instruction, served to duplicate Mr. Atwood's drawing in the film for the stereograph and slide instruction. The illustrations in the film were duplicated by stereographs numbered 276, 219, 275, 428, and 427 and slides numbered 276, 219, 274, 275, 428, and 427 from the Keystone View Company's "600" set.

Each pupil was supplied with one set of the stereographs and one stereoscope for the stereograph instruction so that the time of presentation could be kept constant and no time wasted in passing stereoscopes and stereographs from pupil to pupil. The stereograph and slide instruction took thirteen minutes each.

RESULTS

The average scores made by each group in the threefold tests are shown in Table XXIV.

RESULTS OBTAINED IN THE ORIGINAL TEST

An examination of Table XXIV shows that the film groups made the lowest score in each item of the threefold test. This same result was found in Experiment 10. The slide group made a slightly higher score than the stereograph group on the question test and the chart test, with a difference of .50 points, or 3.4 per cent, and .11 or 3.9 per cent, respectively. However, the stereograph group made a higher score than the slide group in the composition test by 3.25 points or 14 per cent, and in the combined test scores by 2.64 points or 6.4 per cent. The total score made by both the slide and stereograph groups is over 10 points higher than the film group's total score, which, when stated in terms of per cent, shows the slide group to be 35 per cent higher

TABLE XXIV

THE AVERAGE SCORES MADE BY EACH GROUP IN EXPERIMENT 12, SHOWING THE ORIGINAL AND MEMORY-TEST SCORES AND THE PERCENTAGE OF LOSS SHOWN BY THE MEMORY TEST FOR EACH GROUP

ORIGINAL TEST

Group	Grade	No. Pupils	Average Chronological Age	Average Intelligence Test Score	Average Intelligence Quotient	Average Question Score	M.D.	Average Chart Score	M.D.	Average Composition Score	M.D.	Average Total Score	M.D.
Stereograph.....	VII, VIII	37	12.89	86.52	105.14	14.18	3.01	2.78	1.15	26.46	5.43	43.42	6.30
Slide.....	VII, VIII	37	12.75	86.15	106.00	14.68	2.58	2.89	1.04	23.21	4.89	40.78	6.17
Film.....	VII, VIII	37	12.91	86.43	105.89	12.08	2.91	1.65	1.27	16.48	4.98	30.21	5.50

MEMORY TEST (SIX WEEKS)

Group	Grade	No. Pupils	Average Chronological Age	Average Intelligence Test Score	Average Intelligence Quotient	Average Question Score	M.D.	Average Chart Score	M.D.	Average Composition Score	M.D.	Average Total Score	M.D.
Stereograph.....	VII, VIII	37	12.89	86.52	105.14	15	2.15	1.89	.95	14.10	5.11	27.96	7.01
Slide.....	VII, VIII	37	12.75	86.15	106.00	15	2.08	1.81	1.01	14.08	5.08	28.24	6.80
Film.....	VII, VIII	37	12.91	86.43	105.89	7	2.17	1.51	1.10	11.35	4.91	24.08	6.08

than the film group and the stereograph group to be 45 per cent higher than the film group. (Experiment 10 showed the chalk-talk groups to be 35 and 37 per cent higher than the film groups in the total score in Grades VII and VIII respectively.)

RESULTS FROM THE DELAYED RECALL TESTS

The memory test shows the percentage of loss for the film group to be lower than either the stereograph or slide group in each part of the test. A similar result was found in Experiment 10. However, in the residual score the film group is lower than either the slide or stereograph groups. The residual scores made by the slide and stereograph groups are too close together to show any distinct advantage for either group. However, there is one significant difference between the stereograph and slide groups and that is the fact that the stereograph group wrote a larger number of acceptable ideas into its compositions than the slide groups by 14 per cent in the original test and 13 per cent in the memory test. Likewise the stereograph group surpassed the film group in the composition test by 60 per cent in the original test and by 24 per cent in the memory test.

EXPERIMENT 13

TOPIC: *The Steamboat in United States History.*

COMPARISONS MADE

The films that have been described in the foregoing chapters contain a small percentage of action pictures. This fact is shown in Table XXVII. Consequently the writer purposed to secure a film wherein motion was an essential part of the meaning of the picture. After looking for some time, he found a film, parts of which served the purpose.

The experiment was organized to compare the information secured by pupils from one projection of the selected parts of this film, shown in motion, with the information gained from one showing of each scene as a still picture. Such a comparison was made possible by the use of the American projector.

PRESENTATION OF SUBJECT-MATTER

The film which was found to be suitable for Experiment 13 is entitled *The Steamboat in United States History*. Only a part of the film was used. Subtitles marked 1, 2, 3, 4 in the outline of the film which follows, and scenes marked *a*, *b*, *c*, and *d* were selected from the film to form a film which contained no pictures except those of action. Scene *a* showed two men in a canoe paddling downstream and scenes *b*, *c*, and *d* showed models of the early steamboats in motion. The three latter pictures were of the animated cartoon type.

The film presentation required four minutes of actual picture instruction. However, the instruction period was seven minutes long. The film had to be stopped at the end of each scene and subtitle for the same length of time it took to run through that scene or subtitle. This procedure was necessitated by the fact that when a scene or subtitle was shown to the other groups as a "still," the time consumed in running the film through the projector to the next caption or scene had to be duplicated in the film presentation. That is, during the still-picture presentation, which was the same as a stereopticon slide projection, the scene was first shown *still* for the same length of time it took to show the scene while the film was running through the projector. Then the lens was covered and the film was run to the subtitle. The time interval involved in running the film to the next "still" subtitle or scene was duplicated in the film presentation.

The time intervals were determined by carefully timing the film at a set speed with a stop watch, scene by scene and subtitle by subtitle. Aided by an assistant, the writer was able to start and stop the machine, after some practice, so that the time intervals were duplicated in each presentation. The assistant signaled the writer when to start and when to stop by timing each interval with a stop watch.

The outline of the film follows:

SCHOOL FILMS

HISTORY VIII

THE STEAMBOAT IN UNITED STATES HISTORY

Published by
Society for Visual Education, Inc.
Chicago, Illinois

NOTE.—The following subtitles and scenes were taken from the film of the above title for use in Experiment 12.

(Subtitles italicized)

1. *In the early days, transportation by water was slow and laborious.*
 - a) Picture shown of man propelled canoe.
2. *John Fitch proved (1787) that a boat could be propelled by steam power. His invention had paddles like oars.*
 - b) Picture of early model, animated.
3. *Robert Fulton built the first steamboat to achieve real commercial success. The "Clermont" launched on the Hudson in 1807.*
 - c) Picture of animated model of "Clermont" shown.
4. *The "Holyoke" a type of the stern wheel steamer built for inland rivers.*
 - d) Picture of animated model.

RESULTS

The average score made by each group in the threefold test is shown in Table XXV.

The film group in both grades made higher scores in each item of the test. In the fifth grade the film group which saw the action pictures made a score 2.37 points or 29.6 per cent, higher than the slide group on the drawing, and 4.58 points or 35.8 per cent, higher than the slide groups in total score. In the sixth grade the differences are 2.00 points or 16.2 per cent, 4.00 points or 51.9 per cent, and 6.00 points or 29.9 per cent, respectively, in favor of the film group.

The memory-test residual scores show that the film group is again higher in each item of the test in both grades. The percentage of loss in the total score in both grades is lower in the slide group than in the film group. The percentage of loss on

TABLE XXV
THE RESULTS OF EXPERIMENT 13
ORIGINAL TEST, JANUARY 13, 1922

Group	Grade	No. of Pupils	Average Chronological Age	Intelligence Test Score	Intelligence Quotient	Average Question Score	M.D.	Average Drawing Score	M.D.	Average Score	M.D.
A. Film.....	V	19	10.16	52.13	104.37	10.37	3.82	8.37	3.97	18.74	6.14
B. Slide.....	V	19	10.66	52.31	102.1	8.00	5.79	6.16	3.03	14.16	5.11
C. Film.....	VI	20	11.63	70.49	108.15	14.35	6.36	11.70	5.33	26.05	10.6
D. Slide.....	VI	20	11.74	70.95	107.8	12.35	5.41	7.7	4.10	20.05	7.86

MEMORY TEST, MARCH 24, 1922

Group	Grade	No. of Pupils	Average Chronological Age	Intelligence Test Score	Intelligence Quotient	Average Question Score	Percent-age Loss	M.D.	Average Drawing Score	Percent-age Loss	M.D.	Average Score	Percent-age Loss	M.D.
A. Film.....	V	19	10.16	52.13	104.37	10.26	1.1	2.91	7.26	13.30	4.40	17.52	6.6	7.18
B. Slide.....	V	19	10.66	52.31	102.1	7.10	11.3	2.96	6.68	8.4*	5.32	13.78	2.7	6.45
C. Film.....	VI	20	11.63	70.49	108.15	12.30	14.3	3.70	9.9	15.4	3.94	22.20	14.8	7.34
D. Slide.....	VI	20	11.74	70.95	104.37	11.80	3.8	3.75	7.75	.6*	4.72	19.55	2.5	6.25

* Percentage increase.

the other items is irregular when compared group to group and grade to grade. This is significant, and taken with the previous experiments would seem to indicate that a greater percentage of loss is to be expected in the group making the higher initial score, perhaps because they excel in the more difficult parts in the first tests.¹

All of the percentages of loss are small in view of the fact that the tests were given ten weeks after the original test. The two slide groups even recorded a slight percentage of increase in the drawing test.

EXPERIMENT 14

TOPIC: *The Middle Atlantic States.*

COMPARISON MADE

The final experiment was planned to obtain from pupils evidence of their ability to secure information from a unit of geography taught with the aid of stereographs, as compared with the information gained from the same unit taught with the aid of stereopticon slides.

PRESENTATION OF SUBJECT-MATTER

The principal of the Leal School, Miss Wiley, conducted the instruction of each class during the entire period of the experiment. The stereograph group, C, started its study period at 1:30 in the afternoon. Study questions prepared by Miss Wiley for each day, and the text assignment, served as a basis for the pupils' study which was supplemented by the Keystone stereographs assigned to that day's work. The study period was followed by the recitation period, each period being twenty minutes in length.

The study period was supervised by Miss Wiley. Seventeen copies of each stereograph were available, making one stereograph to each stereoscope and one stereoscope for every two pupils. The stereographs were loaned for the experiment by the Keystone View Co.

¹ An exception to this statement will be found in Experiment 6.

The stereopticon group, D, studied the questions outlined by Miss Wiley and the text assignment for that day. Their study material was not supplemented by any pictures except those in the text. The question and text assignment was the same for both groups each day. This study period was supervised by the other sixth-grade teacher, Miss Coombs.

The recitation period for Group D followed the study period. The recitation was conducted by Miss Wiley, and the day's work summarized with the aid of Keystone stereopticon slides which duplicated the stereographs used in Group C.

The experiment lasted nine school days, from February 27 to March 9, 1922. The first seven days were spent on the study of the Middle Atlantic states, and the last two were test days.

A sample of the study questions showing the first textbook assignment and "picture" assignment are given in the following outline.

STUDY QUESTIONS USED BY PUPILS IN EXPERIMENT 14

Text, Brigham and McFarlane's *Geography*, Book II, pages 73-77.

Stereographs and Slides, numbered 26, 48, 61, 50, 61, 48, 43.

Compare Middle Atlantic states in size with Colorado.

What 3 advantages have these states for transportation?

Name 4 physical regions here.

What mountains are in the Appalachian highland?

Atlantic Lowland includes what parts of what states?

What names has the Appalachian plateau here?

Where is the highest part of the group?

Why are lake plains so fertile?

By what 4 rivers is this group drained?

Show where each river rises and into what each flows.

Use pictures to see the surface in different parts and what the rivers are like. Are they young or old rivers?

RESULTS

The regularity of attendance of the pupils in Groups C and D was somewhat broken during the experimental period on account of an influenza epidemic which visited Urbana the first week of March. Only pupils who had been regular in attendance were considered in the final results. The final tabulation of

scores in the equalized groups, after absentees had been thrown out, is shown in Table XXVI

TABLE XXVI

THE AVERAGE SCORES MADE BY GROUPS C AND D IN EXPERIMENT 14

Group	Grade	No. of Pupils	Average Chronological Age	Average Intelligence Test Score	Average Intelligence Quotient	Average Map Score, Part I	M.D.	Average Question Score, Part III	M.D.
C. Stereo-graph...	VI	20	11.66	69.97	107.40	18.00	6.40	60.13	16.52
D. Slide.....	VI	20	11.68	69.90	106.90	15.85	5.44	58.55	16.

An examination of Table XXVI shows that the stereograph Group, C, made higher scores than the slide group in Parts I and III of the test. The stereograph group made a score 13.56 per cent higher than the slide group in the map test, Part I, and a score 2.70 per cent higher than the slide group in the question test, Part III.

The difference between the two groups in Part I of the test is large enough to indicate that the method of using the slide to summarize the study and recitation periods is not as effective as the use of stereographs during the study period, to supplement the study and serve as an aid to discussion during the recitation. The difference between the two groups in Part III of the test is not large enough to be of any significance. The mean deviations in Part III of the test scores are not as high as they appear when one considers the fact that the total possible score on the test was 117 points. The groups were too small to warrant drawing any certain conclusions from Experiment 14.

THE CONTENTS OF EDUCATIONAL FILMS

The seven films which were used in the foregoing experiments were analyzed in terms of their content by a measurement of the footage devoted to subtitles and scenes.

Five classifications of the content of these films were determined as follows:

1. *Subtitles*.—The explanatory language or printed material which appears from time to time during the film's presentation.

The footage included under "subtitles" is that wherein only the printed matter appeared.

2. *Still pictures*.—Scenes, pictures of old prints, aeroplane scenes, scenes of streets, and scenes taken from a train were included under "still pictures." Also pictures wherein motion was not shown except as the camera was in motion.

3. *Action pictures*.—Pictures and scenes wherein action and motion were shown as an essential part of the picture were classified as "action pictures."

4. *Animated cartoons and maps*.—Cartoons, maps, charts, or drawings of the animated type were classified as "animated cartoons and maps." These generally contained animated explanatory printed material.

5. *Still cartoons and maps*.—Same as classification 4 except that the maps, cartoons, etc., were not animated.

An accurate measurement of the footage of each film according to the foregoing classifications was made by the writer in the laboratory of the Society for Visual Education. These measurements and the percentage of the total footage of each film devoted to each classification were then tabulated as shown in Table XXVII.

This analysis shows that the actual percentage of moving or action pictures in the six¹ films combined is 18.20. In other words less than one-fifth of these films represent action. Four of the films contain less than 14 per cent of action pictures and one film has as low as 2.89 per cent of action. The only film wherein action and movement are given prominence is *The Life History of the Monarch Butterfly*. This film contains 58.79 per cent of action pictures.

Fundamentally, those concepts which are dependent on the perception of motion constitute the sort of material in which the moving-picture might make a real contribution to teaching. Five of the six films under consideration were organized around topics from a point of view which did not depend on action. The films represent rather a series of still pictures and animated

¹ The complete analysis of *The Steamboat in United States History* was not made.

TABLE XXVII

THE FOOTAGE AND THE PERCENTAGE DEVOTED BY EACH FILM TO THE FIVE CLASSIFICATIONS OF CONTENT

TITLE OF FILM	SUBTITLES		STILL PICTURES		ACTION PICTURES		ANIMATED CARTOON AND MAPS		STILL CARTOONS AND MAPS		TOTAL	
	No. Feet	Percent- age of Total	No. Feet	Percent- age of Total	No. Feet	Percent- age of Total	No. Feet	Percent- age of Total	No. Feet	Percent- age of Total	No. Feet	Percent- age of Total
Life History of the Monarch Butterfly.....	153	23.18	119	18.03	388	58.79	0	0	0	0	660	100
French Explorations in North America.....	152	20.71	71	9.68	97	13.21	410	55.85	4	.55	734	100
Canals in United States History.....	308	36.98	97	11.65	46	5.52	382	45.85	0	0	883	100
Panama Canal and Its Historical Significance.....	271	31.40	369	42.75	49	5.68	174	20.17	0	0	863	100
Waste Disposal in Cities...	267	25.68	284	27.30	240	23.08	142	13.65	107	10.29	1,040	100
Story of a Mountain Glacier	87	9.68	91	10.14	26	2.89	694	77.29	0	0	898	100
The Steamboat in United States History*	65	56.52	0	0	50	43.48	0	0	0	0	115*	100
Average per cent first six films.....	.....	24.60	.....	19.92	.....	18.20	.....	35.48	.....	1.80	.....	.....

* *The Steamboat in United States History* footage represents the eight scenes and subtitles used in Experiment 13. (See Experiment 13.)

maps (animated in terms of appearing and disappearing legends or a moving line) explained by concise statements in the form of subtitles.

Thirty-five per cent of the footage of the six films under discussion was composed of animated cartoons or maps. In the film, *French Explorations in North America*, the routes taken by the French are shown by a moving black line, and the names of rivers and other legends are flashed in and out of the map. The film, *Waste Disposals in Cities*, shows animated cartoons wherein the sewage flows through pipes, sprinklers, troughs, and beds of rock and sand.

In the *Story of a Mountain Glacier*, 77.29 per cent consists in a picture of Professor Atwood's chalk talk.

However, the action represented by these animated cartoons and maps is not seemingly essential to the formation of the correct concepts of these topics if the results of Experiments 1, 2, 4, 5, and 7 are to be taken as reliable. Furthermore, the lettering which accompanies these animated cartoons and maps shows that even these are dependent on language for their complete understanding.

One-fourth (24.6 per cent) of the films under discussion were made up of pure subtitle material. *Canals in United States History* includes as much as 36.98 per cent of subtitles while the *Story of a Mountain Glacier* had only 9.68 per cent of subtitles. Language is essential in teaching and the persons who would have the film supplant the textbook overlook the large proportion of language material in the film itself.

CONCLUSIONS

Let us go back to Experiment 1 and raise again the three questions brought forward at that point concerning the method of experimentation described herein. One might say: first, that these films were not the best films to teach these units of material; second, that the pupils were trained to learn more economically under ordinary classroom methods than from a film, which is a relatively new method of presenting material to children; and

third, that the tests did not test all the desirable outcomes of film or picture instruction.

The first question involves the problem of best methods of teaching. Let us grant that the films might have been greatly improved. The oral instruction could likewise have been improved. Furthermore, the reader should bear in mind that most of these experiments were not organized especially to determine what is or is not the best method of teaching with a film, but rather to determine which form of presentation, as organized and described in the foregoing pages, would impart the most information to pupils in a given time.

In answer to the second question it has been pointed out that the pupils taking part in all of the experiments (with the exception of the pupils in the Leal School, Urbana, Illinois) had had instruction and experience in learning from pictures and films. Had this factor been of real importance the pupils in the film groups who had been through a second or third experiment would have made scores much higher in proportion than they did in the first experiment. An inspection of the results shows that this is not the case.

The third question raised above calls attention to the point that the experiments reported herein are limited to a consideration of the factual knowledge which each group obtained from the instruction and which it retained.

The writer feels justified in drawing the following conclusions in terms of the factual knowledge imparted to the pupils involved in the fourteen experiments, under the conditions of these experiments and on a basis of the evidence reported.

1. The film entitled *French Explorations in the United States* is not as effective as a teacher using classroom maps in imparting to pupils the information concerning the routes and portages made by the French explorers.

2. Oral instruction illustrated by maps followed by film instruction is more effective than pure film instruction.

3. The oral discussion read before the film on the Panama Canal as shown to Group C, Central School, in Experiment 4,

is not as effective as a single showing of the film itself or as a stereopticon lecture.

4. A stereopticon lecture followed by film instruction is more effective than two showings of the same film.

5. A stereopticon lecture is more effective than the film in teaching material such as that contained in the unit the *Panama Canal and Its Historical Significance*.

6. When the location of the important places is the prime consideration, a close-up relief map of the Panama Canal Zone taught by a stereopticon slide and a teacher is far superior to a flat outline map in black and white taught by the film.

7. The film entitled *The Life History of the Monarch Butterfly* is slightly inferior to oral instruction illustrated by stereopticon slides and to oral instruction illustrated by pictures and sketches, in imparting to pupils the information concerning the life-history of the Monarch butterfly.

8. Place sequence is taught, under the conditions of Experiments 1, 2, and 7, more effectively by teacher-chart instruction than by film instruction.

9. An analysis of test papers from the experiment with the film *Waste Disposal in Cities*, shows that the film needs elaboration and explanation at various points to make it as effective as oral-chart instruction either in teaching a place sequence or in presenting a picture for analytical study.

10. Pupils living in an inland city who have not experienced seeing the "tide going out to sea" can be taught this fact more effectively by a motion picture film than by oral instruction.

11. It is more effective to give verbal explanation during the showing of a film than to present the film without comment, provided the person giving the verbal explanation has seen the film before the presentation and has worked out his statements carefully.

12. Films containing a high percentage of action pictures are more effective than still pictures for presenting certain types of material and approach the teacher situation in effectiveness.

13. Language is a necessary accompaniment of concrete experience.

14. The motion picture films herein described are inflexible units which lack the flexibility of the teacher-language-chart situation. This can be remedied in part by stopping the film for comment or by explanatory material given during the projection of the film. (NOTE.—The words stereograph, slide, still picture, map, or diagram can be substituted for the word “chart,” in the compound word “teacher-language-chart” above, with the same meaning.)

15. The film groups suffered a lower percentage of loss in the memory tests than groups which were given other methods of presentation with one exception, Experiment 13, where the film was compared with the slide. When the film group made a lower score than the group with which it was compared in the initial test, it also made a lower score in the final test in spite of the fact that it suffered less loss, this was true in every individual comparison but one.

16. The attention of pupils to the presentation of a moving-picture film is not 100 per cent, and is not appreciably higher than the attention of pupils to the teacher-chart situation.

17. The teacher's ability to call the attention of the pupils to important facts and relationships is missing in the films herein described and should be supplied if possible.

18. The stereograph is seemingly superior to the stereopticon slide or film as a supplementary aid in teaching material such as *The Story of a Mountain Glacier*.

19. The stereograph used to supplement a study period in geography is more effective than the stereopticon slide used to summarize the period of study.

20. In order to be effective moving-picture instruction must be connected with the pupil's past experience in terms of language.

CHAPTER II

A COMPARISON OF THE TEACHING VALUE OF FILM AND OF ORAL INSTRUCTION IN THE CASE OF TWO SHORT PROJECTS AND ONE LONGER PROJECT

E. H. REEDER AND FRANK N. FREEMAN

The problems in these experiments were the same as that in the earlier experiments by McClusky, and in those which were carried out by James. A considerable number of educational films have been produced for the purpose of teaching facts. The aim of these films is to give information, in the same way as the textbook or the oral lecture may have as its purpose giving information. It is often asserted, moreover, that motion picture films are much more effective as means of giving information than is the lecture or the textbook. These experiments are for the purpose of gaining additional evidence concerning this aspect of the use of educational films.

EXPERIMENT WITH TWO SHORT PROJECTS EACH OF WHICH OCCUPIES ONE LECTURE PERIOD

The two short projects consisted of the use of two films. The first is entitled *Reclaiming Arid Lands by Irrigation*, and was produced by the Society for Visual Education. The second is *Orange Culture*, and was produced by the Fruit Growers' Association of Southern California.

DESCRIPTION OF THE FILMS AND OF THE TESTS

The nature of the films may be gathered from the forewords and examples from the titles.

The reel, *Reclaiming Arid Land by Irrigation*, is planned to show, first, the great need for irrigation in our arid West; second, the areas reclaimed by various private and public enterprises, among the most important of which is the United States Reclamation Service; third, how the farmer irrigates his fields and what

sort of crops are raised by irrigation throughout the West; and last, some of the great dams, reservoirs, and tunnels by which the stream waters have been made to serve man's purpose.

OUTLINE OF CONTENTS

(Subtitles italicized)

Scenes in this reel are shown by courtesy of the United States Reclamation Service

The ground is fertile—only water is needed

View of the desert before irrigation

The desert farmer's first task

Scene showing clearing and burning brush

Digging ditches in the fields

Views of furrowing machine at work, and water flowing into furrows

Some crops require frequent irrigating

Irrigation in pear orchard

Irrigation makes possible abundant crops

Fruit-growing in the Yakima Valley, Washington's "Vale of Plenty"

View of Yakima peach orchard

Grain harvests on irrigated land, Newland's Project, Nevada

Scene shows harvesting of oats

Sugar beets grown by irrigation, Huntley, Montana

Beet field, Huntley Project, and scene of men chopping tops off beets

Yuma Projects claims the best cotton in the world, grown by irrigation along the lower Colorado River

Cotton field and close view of plant and cotton boll

Southwestern deserts are transformed into orange and lemon groves.

Views of Riverside orange groves and lemon groves at Yuma, with close-up pictures of the fruit

Almonds ripen in the semi-tropical climate of California

Views of almond groves and close-up views of almonds on trees

Dates, the Old World "Bread of the Desert," are grown in the Colorado River Delta

Date palms and fruit

Why is irrigation necessary?

About one-fifth of all land in the United States is too arid for agriculture

The test which was used for this film and for the parallel oral instruction is given in full in order to illustrate the two types of questions which were asked. The first series of questions, numbered 1-13, were based upon the information which was given through the subtitles. The second series of questions,

numbered 1-12, were based upon the information which was secured through the pictures themselves. The purpose of this classification of questions was to determine whether or not the film was more effective in the information which was conveyed in the captions, or in that which might be gathered from the pictures themselves.

1. The ground where irrigation is carried on is $\left\{ \begin{array}{l} \text{rich.} \\ \text{poor.} \end{array} \right.$
2. Yakima Valley is in the state of $\left\{ \begin{array}{l} \text{California.} \\ \text{Montana.} \\ \text{Washington.} \end{array} \right.$
3. The cotton which is grown by irrigation is on land near the $\left\{ \begin{array}{l} \text{Colorado} \\ \text{Rio Grande} \end{array} \right\}$ River.
4. Oranges and lemons in $\left\{ \begin{array}{l} \text{Florida} \\ \text{California} \end{array} \right\}$ are grown by irrigation.
5. $\left\{ \begin{array}{l} \text{Almonds} \\ \text{Pecans} \end{array} \right\}$ are grown in irrigated land in California.
6. $\left\{ \begin{array}{l} \text{Bananas} \\ \text{Dates} \end{array} \right\}$ are called the bread of the desert in the Old World.
7. About $\left\{ \begin{array}{l} \text{one-tenth} \\ \text{one-third} \\ \text{one-fifth} \end{array} \right\}$ of the land in the United States is too dry for farming.
8. $\left\{ \begin{array}{l} \text{All} \\ \text{Not} \end{array} \right\}$ all of the irrigation has been provided for by the United States government.
9. The reservoirs are located in the $\left\{ \begin{array}{l} \text{mountains.} \\ \text{valleys.} \end{array} \right.$
10. Low dams divert the water into $\left\{ \begin{array}{l} \text{canals.} \\ \text{reservoirs.} \end{array} \right.$
11. The Gunnison Tunnel carries the water underground for $\left\{ \begin{array}{l} \text{six miles.} \\ \text{two miles.} \end{array} \right.$
12. The water in the Roosevelt Dam would cover the state of ——— one $\left\{ \begin{array}{l} \text{foot} \\ \text{inch} \end{array} \right\}$ deep.
13. Before irrigation, land on the Yuma project was worth ——— to ———. After irrigation it was worth ——— to ———.
1. To prepare for irrigation the farmer prepares the ground by ———.
2. Before irrigation the ground is covered with $\left\{ \begin{array}{l} \text{brush.} \\ \text{trees.} \end{array} \right.$
3. The ground is first irrigated $\left\{ \begin{array}{l} \text{before} \\ \text{after} \end{array} \right\}$ the trees are planted.

4. Irrigation $\left\{ \begin{array}{l} \text{is not} \\ \text{is} \end{array} \right\}$ used in growing grain as well as fruit.
5. The sugar beets are $\left\{ \begin{array}{l} \text{light colored.} \\ \text{dark colored.} \end{array} \right\}$
6. The cotton plant is a $\left\{ \begin{array}{l} \text{tree.} \\ \text{bush.} \end{array} \right\}$
7. Almonds have ——— shells or coverings.
8. The branches of a date palm $\left\{ \begin{array}{l} \text{grow on a tall stem or trunk.} \\ \text{come out from the same place near the} \\ \text{ground.} \end{array} \right\}$
9. The arid (dry) land is mostly $\left\{ \begin{array}{l} \text{west} \\ \text{east} \end{array} \right\}$ of the Mississippi River.
10. The land which has been reclaimed by private persons, corporations, or states is $\left\{ \begin{array}{l} \text{scattered all over the dry area.} \\ \text{confined to a few states.} \end{array} \right\}$
11. The reservoirs are usually between $\left\{ \begin{array}{l} \text{low} \\ \text{high} \end{array} \right\}$ banks.
12. The Roosevelt Dam curves $\left\{ \begin{array}{l} \text{inward toward the reservoir.} \\ \text{outward from the reservoir.} \end{array} \right\}$

The character of the orange film may be gathered from the test questions.

The questions which were used in the test upon the Orange lesson are as follows:

1. The seeds of orange trees are planted in the $\left\{ \begin{array}{l} \text{sun.} \\ \text{shade.} \end{array} \right\}$
2. There are ——— trees planted in an acre.
3. The buds which are put on the seedlings are from trees ———.
4. The paper collars which are put around the young trees are to ———.
5. The water for irrigation comes from the ———.
6. Each year ——— dollars are spent in fumigation.
7. The fumigation is to kill ———.
8. Fumigation lasts ——— minutes.
9. Frosts often destroy a $\left\{ \begin{array}{l} \text{large} \\ \text{small} \end{array} \right\}$ part of the fruit.
10. When older trees are budded, the ends of the limbs are painted to ———.
11. Older trees bear fruit in ——— years after they are budded.
12. The packing-houses are owned by $\left\{ \begin{array}{l} \text{the men who grow the fruit.} \\ \text{companies formed to sell the fruit.} \end{array} \right\}$
13. The boxes $\left\{ \begin{array}{l} \text{are not} \\ \text{are} \end{array} \right\}$ made by the growers' association.
14. The oranges are graded for form and color by $\left\{ \begin{array}{l} \text{hand.} \\ \text{machines.} \end{array} \right\}$
A packer fills ——— boxes a day.
15. Fruit should be eaten to ——— the diet.

1. The young seedlings $\left\{ \begin{array}{l} \text{are} \\ \text{are not} \end{array} \right\}$ moved after they have grown for awhile.
2. After the seedling is budded the top is— —.
3. When older trees are budded the limbs $\left\{ \begin{array}{l} \text{are} \\ \text{are not} \end{array} \right\}$ cut off.
4. The oranges are picked $\left\{ \begin{array}{l} \text{with} \\ \text{without} \end{array} \right\}$ gloves.
5. They are handled $\left\{ \begin{array}{l} \text{carelessly.} \\ \text{carefully.} \end{array} \right\}$
6. The oranges are washed by $\left\{ \begin{array}{l} \text{hand.} \\ \text{machinery.} \end{array} \right\}$
1. Oranges are grown $\left\{ \begin{array}{l} \text{in the valleys.} \\ \text{on the mountain side.} \end{array} \right\}$
2. Seeds are planted $\left\{ \begin{array}{l} \text{by hand.} \\ \text{by machines.} \end{array} \right\}$
3. The buds are placed under the ——— of the seedling.
4. The young trees are washed with a ———.
5. In irrigation the water runs in ditches.
6. The fumigating tents are put over the trees with the help of $\left\{ \begin{array}{l} \text{ladders.} \\ \text{derricks.} \end{array} \right\}$
7. On cold nights the trees are kept warmer by fires $\left\{ \begin{array}{l} \text{in stoves.} \\ \text{on the ground.} \end{array} \right\}$
8. Oranges are picked in $\left\{ \begin{array}{l} \text{baskets.} \\ \text{bags.} \end{array} \right\}$
9. The boxes are made by $\left\{ \begin{array}{l} \text{machinery.} \\ \text{hand.} \end{array} \right\}$
10. The oranges run down between the rollers in being sorted; the smallest ones fall through $\left\{ \begin{array}{l} \text{first.} \\ \text{last.} \end{array} \right\}$
11. The ice is put into the $\left\{ \begin{array}{l} \text{side} \\ \text{top} \end{array} \right\}$ of the cars.
12. After the buds are put in place in budding, the bark is kept down by ———.
13. When one tree has been fumigated the next tree is covered by pulling the tent to $\left\{ \begin{array}{l} \text{the ground and then lifting it up again.} \\ \text{right over.} \\ \text{from one tree to the next.} \end{array} \right\}$
14. The oranges are wrapped by $\left\{ \begin{array}{l} \text{first taking the orange and then putting} \\ \text{the paper around it.} \\ \text{first taking the paper in the hand and} \\ \text{then putting the orange in it.} \end{array} \right\}$

THE ORGANIZATION OF THE PARALLEL GROUPS

The comparison between the films and the oral instruction was made by showing the films to one class and giving the parallel oral instruction to another class. The two classes were members of the fourth grade in the city of Detroit. There were forty children in each class. In order to secure groups for comparison which were equal in the various characteristics which might appreciably affect their score, matched pairs were made from

TABLE I

DATA ON THE MATCHED PAIRS WHO WERE USED IN THE EXPERIMENT
WITH THE IRRIGATION AND THE ORANGE FILMS AT
THE DOTY SCHOOL

PAIR No.	VISUAL GROUP				ORAL GROUP			
	Age	Sex	Int.	Init.	Age	Sex	Int.	Init.
1.....	8½	f	55	46	9	f	61	42
2.....	9	m	91	78	9	f	84	78
3.....	9	f	83	58	9	f	85	46
4.....	10	m	101	72	10	m	106	66
5.....	10	m	86	60	10	f	81	60
6.....	10	f	86	52	10	f	86	54
7.....	10	m	72	64	10	f	73	66
8.....	10	m	72	58	10	m	79	36
9.....	10	m	94	76	10	f	85	80
10.....	10	m	80	52	10	m	68	84
11.....	10½	f	84	82	10½	m	83	88
12.....	10½	m	96	46	10½	m	84	48
13.....	11	f	91	96	10½	f	77	38
14.....	10½	m	93	26	10½	m	90	58
15.....	10½	m	55	80	10½	f	51	48
Averages.	9.93	.....	83	63	9.96	.....	86	59

the two groups in the following manner. A child from one group and a child from the other group were selected who were of the same sex, of the same age, and who made the same score as far as possible in an intelligence test and in a preliminary test of the subject-matter of the instruction. In some cases it was not possible to match in all respects, but the exceptions were made as few as possible. The data concerning these matched pairs in the Doty School are given in Table I. It will be seen that the

averages of the visual group and the oral group in age, intelligence, and the initial test are very nearly alike.

THE ORGANIZATION OF THE PARALLEL INSTRUCTION

The oral instruction, which was given to the group paralleling the film group, was made up in the following manner. Miss Lillian Norconck, the social science teacher of the Doty School, viewed the film several times, and studied the copy of the subtitles which was given to her. On the basis of this inspection she organized the lesson which she taught orally at the same period that the other group was being shown the film. Miss Norconck did not, however, see the test before she taught the lesson.

RESULTS

Table II shows the distribution of the results of the tests. In the first test on the subject of irrigation, the medians of the two groups are practically the same. In the second test, the medians are nearly the same, namely, 21.5 for the visual group and 23.5 for the oral group. Of the matched pairs in the first test, in eight cases the pupil in the visual group received the higher score, one pair received the same score, and in six cases the pupil in the visual group received the lower score. In the second test, however, only two pupils in the visual group received a higher score than those who were matched with them, while ten of the visual group received lower scores than those in the non-visual group who were matched with them. The distribution of intelligence scores and initial test scores closely approximate the test-score distributions.

The results of these experiments, although so small a number of cases was used, seem to show that there is little if any difference in the effectiveness of visual and oral methods in presenting facts. This suggests a theory of the value of the motion picture which should receive further experimental research. This theory is that oral instruction may be as effective as instruction with the aid of pictures in cases in which the pupils' experience enables them to interpret the oral lecture.

TABLE II
DISTRIBUTION OF THE SCORES IN THE EXPERIMENTS
WITH THE IRRIGATION AND THE ORANGE FILMS

SCORES	NO. OF CASES	
	Visual	Oral
Irrigation Film		
22.....		1
21.....		
20.....	3	1
19.....	2	2
18.....	2	3
17.....	2	1
16.....	2	3
15.....		1
14.....	2	2
13.....	1	1
12.....	1	
Median.....	17.8	17.5
Orange Film		
31.....		1
30.....		1
29.....	1	
28.....		
27.....		
26.....		3
25.....	3	
24.....	1	1
23.....	1	1
22.....	1	
21.....	1	1
20.....	1	1
19.....	1	1
18.....		
17.....	1	1
16.....		
15.....		
14.....	1	
13.....		1
12.....		
11.....	1	
Median.....	21.5	23.5

EXPERIMENT WITH A LONG PROJECT

THE EFFECTIVENESS OF VISUAL AIDS IN TEACHING
A LONG PROJECT

It is possible that while motion pictures and other visual materials are not greatly superior to other methods of presentation in the teaching of some facts they are of great value in stimulating interest in the subject and giving the material for thought which will illuminate and make more accurate the pupil's reading in other cases in which the pupils' experience is more limited. Study of this broader effect of visual aids can better be made by means of longer experiments than the ones which have already been described. Two studies have therefore been made which lasted through a period of four weeks. These studies both dealt with the same subject, and in both the same visual materials were used. The subject was the study of Egypt from a geographical standpoint. One of the studies was made in the Lingemann School, Detroit, and the other at the Columbian School. The purpose of repeating the study in the second school was to determine whether or not minor differences in the use of the visual aids or in the oral instruction would account for whatever results appeared. If the results of the experiments in the two schools were similar it would be much more reliable than if the two studies did not agree.

The detailed plan of the work cannot be presented in this report. It was of too long duration and is too detailed for such presentation. The lesson plan for the entire four weeks' work was drawn up by the teachers who were engaged in the experiment and was submitted to the experimenters. After the general plan had been thus arranged, the children were divided into two groups. One of these groups was taught the work which was outlined, without any visual materials. The other group was taught by the use of all of the visual material which could be secured. This included four films, and many slides and stereographs, and a trip to the children's museum, at which the children were shown Egyptian curios.

Since the experiments in the two schools differ somewhat in detail, we may describe them individually.

EXPERIMENT AT THE LINGEMANN SCHOOL

The experiment in the Lingemann School was carried out with two classes. The total membership of each class was thirty. The entire membership was not used on account of the necessity of using only matched pairs. The children of the two classes were matched on the basis of intelligence scores and reading tests. In all, seventeen matched pairs were obtained in this fashion. Table III shows the characteristics of these pairs, including sex, intelligence score, reading score, and age.

At the expiration of the teaching period of four weeks, three tests were given. The first of these is a completion test consisting of fifty items made by the teacher of the class, Miss Virginia West. The entire test is reproduced in order to give an idea of the subject-matter which was covered in the project. Supplementary to this completion test, a "Yes and No" test was given. This test is also appended.

QUESTIONS ON EGYPT

1. The country which occupies the northeastern part of Africa is ———.
2. Egypt is situated in the eastern part of the ——— desert.
3. Most of Egypt lies in the ——— zone.
4. The climate of Egypt is therefore very ———.
5. The climate of northern Egypt is ——— and ———.
6. With the aid of irrigation the Egyptians are able to raise ——— and ——— crops per year.
7. Egypt is situated on the ——— Sea so as to carry on trade with Europe.
8. The ——— Sea is the highway for Asia and the Far East.
9. Asia and Africa are joined in the country of ———.
10. The greater part of Egypt is a ———.
11. The rich soil and level land is in the ——— part of Egypt.
12. At the city of Cairo, the Nile divides into ———.
13. The river which has its source in this high land is the ———.
14. The Nile receives all of its water in the ———.
15. The Nile has cut a ——— in its course.
16. The high plateau of Egypt is in the ——— part.
17. The Nile has built a ——— at its mouth.

TABLE III
CONSTITUTION OF THE PARALLEL GROUPS IN THE
EXPERIMENT WITH THE LONG PROJECT IN
THE LINGEMANN SCHOOL

PAIR No.	VISUAL			NON-VISUAL		
	Sex	Intelligence	Reading Score	Sex	Intelligence	Reading Score
10 and 10½ Years						
1.....	f	49	2	m	35	2
2.....	f	39	1	f	35	1
3.....	f	33	3	f	35	3
11 Years						
4.....	m	69	1	f	77	1
5.....	m	52	2	m	52	2
6.....	f	52	1	f	50	1
7.....	f	43	1	f	41	1
8.....	m	54	1	m	67	1
9.....	m	26	4	m	29	4
11½ and 12 Years						
10.....	m	50	1	m	47	1
11.....	f	31	4	f	28	3
12.....	f	65	1	f	59	1
13.....	m	42	2	f	49	1
12½ and 13 Years						
14.....	m	30	4	f	31	4
15.....	m	24	4	f	25	2
13½ Years						
16.....	m	40	4	m	32	3
14 Years						
17.....	m	39	.....	m	40	4
Median..	.....	43.5	.....	.....	42.5	.....

18. The delta has been built up with the ——— of the Nile.
19. In southern or upper Egypt the waters of the Nile ——— a deposit of ———.
20. The Nile River is used by ——— and ——— boats.
21. The water for irrigating lower Egypt is held back by the dam at ———.
22. The dam was built by the ———.
23. The water is raised to the fields by means of ———.
24. In size, Egypt is equal to ———.
25. The fertile part of Egypt is equal to ———.
26. The great population of Egypt live near the ———.
27. The most important crops are ——— and ———.
28. The most important industry of the Egyptians is ———.
29. The tropical fruits are ———, ———.
29. The important animals of Egypt are ———, ———, ———.
30. The camel is used because ———.
31. The capital and largest city of Egypt is ———.
32. The chief seaport is ———.
33. The pyramids are thousands of years old, yet they are remarkably preserved because ———.
34. These pyramids were built for the ———.
35. The canal which has been built in Egypt is the ———.
36. This canal connects the Mediterranean Sea and the ——— Sea.
37. The Suez Canal is ——— miles in length.
38. The Suez Canal was built by the ———.
39. It was easier to build the Suez Canal than the Panama Canal because ———.
40. The Suez canal shortens the route between ——— and Asia.
41. The ruler of Egypt is called the ———.
42. Egypt is controlled by ———.
43. The Egyptian people are not leaders today as they were in ancient times because ———.
44. The Egyptians depended for years on the ——— for the growing of crops.
45. The British built a dam at ——— similar to the Roosevelt dam in Arizona.
46. ———, ———, ———, ——— are the chief crops of Egypt.
47. The great navigable river of Egypt is the ———.
48. Man has built a ——— at the mouth of the Nile.
49. ——— is a very important seaport on the Mediterranean.

TEST 1. EGYPT (YES AND NO)

1. Most of Egypt has rich and fertile, well-watered fields. ()
2. Most of the people live in the region of the Nile. ()
3. The layer of soil desposited by the Nile is harmful to the farmer. ()

4. The British government has improved the method of irrigation. ()
5. The climate of Egypt is not warm enough for two crops per year. ()
6. The Egyptians manufacture their cotton in their mills. ()
7. Cairo is very much like an American city. ()
8. The history of the king was written in books similar to our school histories. ()

The distribution of the scores in this test is shown in Table IV. It will be seen that the two groups made the same

TABLE IV
DISTRIBUTION OF THE SCORES OF THE VISUAL
AND NON-VISUAL GROUPS IN TEST I,
LINGEMANN SCHOOL

Scores	Visual	Non-Visual
40-44.....	3	2
35-39.....	3	5
30-34.....	4	2
25-29.....	3	3
20-24.....	2	3
15-19.....	1	1
10-14.....	1	.....
5-9.....	.....	1
Median.....	31.3	31.3

score, the median being 31.3 in each case. The arithmetical averages are also substantially the same, namely, 30.51 for the visual group, and 30.06 for the non-visual group. In nine cases the pupils in the visual group received a better score than those that were matched with them in the visual group, and in eight cases a poorer score.

In order that the measurements of the results of the instruction might be as adequate as possible, a second test was given to the pupils. This test is also reproduced in its entirety.

TEST No. 2. EGYPT

1. Egypt has a { hot
temperate } climate because { the pyramids are there.
cold } { it is mostly in the torrid
zone.
it is mostly in the temperate
zone.

2. The pyramids are $\left\{ \begin{array}{l} \text{smaller} \\ \text{as large as} \\ \text{larger} \end{array} \right\}$ than our school building.
3. The farmers of Egypt wear $\left\{ \begin{array}{l} \text{overalls.} \\ \text{trousers.} \\ \text{long robes.} \end{array} \right\}$
4. The Nile River makes it $\left\{ \begin{array}{l} \text{easier to raise crops} \\ \text{harder} \end{array} \right\}$ because $\left\{ \begin{array}{l} \text{it rises in the} \\ \text{mountains.} \\ \text{it overflows its} \\ \text{banks.} \\ \text{it has a delta at} \\ \text{its mouth.} \end{array} \right\}$
5. The head of the Sphinx looks like a $\left\{ \begin{array}{l} \text{bird.} \\ \text{human being.} \\ \text{house.} \end{array} \right\}$
6. The streets of Cairo $\left\{ \begin{array}{l} \text{do} \\ \text{do not} \end{array} \right\}$ look like Detroit streets.
7. Great Britain built the great Assuan Dam, making it $\left\{ \begin{array}{l} \text{easier} \\ \text{harder} \end{array} \right\}$ to farm in Egypt because $\left\{ \begin{array}{l} \text{it is a large dam.} \\ \text{it is built of concrete.} \\ \text{it makes irrigation possible.} \end{array} \right\}$
8. Derricks and steam engines $\left\{ \begin{array}{l} \text{were} \\ \text{were not} \end{array} \right\}$ used to build the pyramids. because $\left\{ \begin{array}{l} \text{the pyramids were built long ago.} \\ \text{the kings built the pyramids.} \\ \text{they are so large.} \end{array} \right\}$
9. Children in the schools of Egypt study $\left\{ \begin{array}{l} \text{geography.} \\ \text{religion.} \\ \text{nature study.} \end{array} \right\}$
10. In farming the Egyptians use $\left\{ \begin{array}{l} \text{tractors.} \\ \text{hand methods.} \\ \text{wind mills.} \end{array} \right\}$
11. Camels are used in Egypt because $\left\{ \begin{array}{l} \text{they have humps on their backs.} \\ \text{they travel slowly.} \\ \text{they can go a long time without water.} \end{array} \right\}$
12. An oasis is a place in the desert where there are $\left\{ \begin{array}{l} \text{grass and trees.} \\ \text{sand hills.} \\ \text{cataracts.} \\ \text{obelisks.} \end{array} \right\}$
13. The area of Egypt is $\left\{ \begin{array}{l} \text{greater than} \\ \text{as large as} \\ \text{smaller than} \end{array} \right\}$ that of the United States.

14. Egypt is controlled by { United States.
France.
Germany.
Great Britain.
15. Alexandria is located { on the Mediterranean.
on the Red Sea.
near the Sphinx.
16. The temples of Egypt were built ——— years ago.
17. The Nile River ——— its banks, and leaves ——— along its banks.
18. An ——— from Egypt is in Central Park, New York.
19. The southern part of the Nile River has many ———.
20. The Suez Canal connects the ——— Sea with the ——— Sea.
21. Has Egypt many rivers?
22. Did the ancient Egyptians use pen and ink to write letters?
23. Do Egyptians weave wool cloth by hand?
24. Is an obelisk a temple?
25. Do people travel all the way from Cairo to the Sphinx by train?

This test (Table V), as Test 1, gave the same mid scores for the visual and non-visual groups, namely, 22. The arithmetical

TABLE V
DISTRIBUTION OF THE SCORES OF THE VISUAL
AND NON-VISUAL GROUPS IN THE SECOND
TEST, LINGEMANN SCHOOL

Scores	Visual	Non-Visual
25.....	.....	1
24.....	.....	2
23.....	1	1
22.....	5	2
21.....	2	3
20.....	.....	1
19.....	3	1
18.....	1	1
Median score.....	22	22

averages are also practically the same. One pair in this test received the same score. In four cases children in the visual group received better scores than those matched with them, and in seven cases poorer scores.

The third test consisted of writing a composition on the subject, "What I Have Learned about the Pyramids." Papers

were scored by students at the Detroit Teachers College on the Traube extension of the Hillegas Composition Scale. The results of this test were strongly in favor of the visual group. The distribution is shown in Table VI. The visual group had a median of 57.5 and the non-visual 50. The average of the visual group is 52 and the non-visual 42.

It is difficult to know how to interpret these results. In testing the results of such a procedure as is outlined above, it is impossible to say precisely what we are testing. Are we testing

TABLE VI
DISTRIBUTION OF THE SCORES OF THE VISUAL AND
NON-VISUAL GROUPS IN A COMPOSITION
TEST, LINGEMANN SCHOOL

Scores	Visual	Non-Visual
65-69.....	4	.....
60-64.....	2	.....
55-59.....	3	1
50-54.....	1	5
45-49.....	2	2
40-44.....	.....	3
35-39.....	1	1
30-34.....	1	.....
25-29.....	.....	.....
20-24.....	.....	.....
15-19.....	.....	.....
10-14.....	1	.....
Median.....	57.5	50

the ability of the teacher to use visual aids? Are we testing the individual films and slides? Or are we testing the value of visual education? The only test which shows any real difference between the two groups is the composition test. This might be due to the greater stimulation of the visual methods, or it might be due to a difference in the composition ability of the two groups. Certainly the results of the tests are not by any means decisive. Further experiments to test the value of visual aids in stimulating good composition work are clearly needed. The results of these experiments must be interpreted in the light of others which bear on the same problem.

EXPERIMENT AT THE COLUMBIAN SCHOOL

The experiment in the Columbian School was organized in the same manner as the one in the Lingemann School, except for the differences which are noted below.

CONSTITUTION OF THE PARALLEL GROUPS

The children who were used in this experiment as subjects were from the Grade V B, two classes, containing eighty children. From these, thirty matched pairs were secured. The constitution of these matched pairs is shown in Table VII. This table shows the sex, the intelligence score, the reading score, and the age of each of the children. Unfortunately the groups were not well matched, as the average intelligence score of the visual group is 2.5 points higher than that of the non-visual group.

THE TESTS

The first test of this experiment was different from that used at the Lingemann School since it was made out by the teacher of the groups in this experiment. This test is given in its entirety to indicate its nature and to give further data concerning the character of the subject-matter which was taught in the project.

QUESTIONS ON EGYPT

1. Civilized people lived in Egypt ——— of years before the time of Christ.
2. The Egyptian writing was in the form of ——— or ——— writing.
3. The embalmed bodies of the ancient Egyptians are called ———.
4. Egypt is in the ——— part of Africa.
5. Egypt has today a population of over ——— people.
6. Egypt has today a population of over ——— people.¹
- ¹ This repetition was an error in the mimeographed test.
7. The Nile River flows ——— through the country of Egypt and empties into the ——— sea.
8. The Nile River carries ——— to its ——— and there deposits it.
9. The ancient Egyptians in irrigating their land during periods of low water used a device called ———.
10. The ——— government has built a dam at ——— to form a reservoir.
11. The water stored in the reservoir is used to ——— the fields, and this increases the amount of land that may be ———.
12. The climate of Egypt is very ——— and there is but little ———.
13. The Suez Canal is operated by ———.

TABLE VII
CONSTITUTION OF THE MATCHED GROUPS USED IN THE
LONG PROJECT AT THE COLUMBIAN SCHOOL

PAIR NO.	VISUAL			NON-VISUAL		
	Sex	Intelligence	Reading Score	Sex	Intelligence	Reading Score
9½ and 10 Years						
1.....	f	26	4	m	21	3
2.....	m	56	5	m	35	3
10½ Years						
3.....	f	44	12	f	46	9
4.....	f	42	6	f	38	7
5.....	m	36	8	m	37	8
6.....	m	47	8	m	43	8
7.....	m	41	7	m	39	10
8.....	f	36	10	f	55	12
11 Years						
9.....	f	21	8	f	27	5
10.....	f	48	9	f	47	8
11.....	m	49	8	f	35	9
12.....	f	64	10	f	44	9
13.....	f	40	8	f	41	7
14.....	f	34	7	f	35	9
15.....	f	47	10	f	41	10
16.....	m	33	9	f	28	6
11½ Years						
17.....	m	36	4	m	35	4
18.....	m	64	9	f	63	9
19.....	m	27	4	f	22	8
20.....	m	33	6	f	37	5
21.....	f	49	8	m	52	8
22.....	m	36	10	m	46	6
12 Years						
23.....	m	33	4	m	31	4
24.....	m	45	8	m	46	9
25.....	f	34	5	f	23	3
12½ and 13 Years						
26.....	f	29	5	f	22	5
27.....	m	46	9	m	48	7
28.....	f	66	11	f	55	9
29.....	f	49	3	f	41	9
14 Years						
30.....	f	28	7	f	33	2
Average....	42.7			40.2		

14. Next to the ——— Canal it is the most important.
15. In normal times about ——— ships pass through the Suez Canal yearly.
16. The building of this canal has made commerce through the ——— important.
17. This canal has opened a direct route from the continent of ——— to the continent of ———.
18. ——— is the chief industry.
19. The important crops are ——— and ———.
20. The Egyptians use the ——— method of sowing their crops.
21. They thresh their wheat by ——— the grain with ———.
22. Egypt stands next to ——— in the production of cotton.
23. The ——— land in Egypt is about the size of our state of ———.
24. The domestic animals in Egypt are ———, ———, ———, ———.
25. In Egypt we find deserts; the largest are the ——— and ———.
26. An ——— in a desert is a place where ——— and ——— grow.
27. ——— from the palm trees form another important product.
28. The ——— and capital of Egypt is the city of ———.
29. The people of the poorer classes beg for ———.
30. The men wear ——— caps on their heads and ——— of white.
31. The women wear ——— on the lower part of their faces.
32. The Great Nile Bridge is open for the passage of boats no longer than ——— a day.
33. The Egyptians are mostly of the ——— faith.
34. The ——— is the Bible of the Mohammedans.
35. Education in Egypt consists largely in ———.
36. The Mohammedans visit the city of ——— each year.

YES AND NO

37. Are the women of Egypt as well educated as the men?
38. Does Egypt rule herself?
39. Is she under the protection and guidance of Great Britain?
40. Is Alexandria as large as Cairo?
41. Is there a great deal of traffic across the Nile Bridge into Cairo?
42. Do little children carry water vessels on their heads?
43. May an Egyptian wear his shoes upon entering a mosque?
44. Do many of the women of Egypt visit the mosques?
45. Can many of the women of Egypt read and write?
46. Does the Khedive always go with the pilgrims to visit Mecca?
47. Is the Mahmal sent as his proxy when he cannot himself attend?
48. Were the pyramids erected as burial places for the ancient kings?
49. Were these same pyramids built in a short space of time?
50. Did the ancient Egyptians use granite blocks in the building of these pyramids?
51. If you were to visit Egypt today would you find the pyramids?

52. Did they make huge columns for their temples in the same way as they built the pyramids?
53. Were the obelisks made of small pieces of granite?
54. Would you find Egyptian hieroglyphics on these obelisks?
55. Is the monument called Cleopatra's Needle in Central Park, New York, an obelisk from Egypt?
56. Is the Sphinx a pyramid?
57. Are the Sphinx and the pyramids built near the city of Cairo?
58. Are the obelisks sent to New York, London, and Rome as durable in these moist climates as they were at home?
59. Did the royal ancient Egyptians build tombs other than the pyramids?
60. Are there many temples or mosques in Cairo?
61. Has Egypt progressed since the world-war?
62. Do people from Europe and America spend their winters in Egypt?
63. Have the people taken up the customs of the Europeans very quickly?
64. Do the Egyptians of the present day know how to embalm bodies as well as the ancient Egyptians?
65. May an Egyptian have more than one wife?
66. Are the Egyptians careless about the cleanliness of their bodies?

The second test is not repeated here since it is the same one as was given in the Lingemann School.

RESULTS

The distribution of the scores in the first test is given in Table VIII. It will be seen that the visual group here made the

TABLE VIII
DISTRIBUTION OF SCORES OF THE VISUAL AND
NON-VISUAL GROUPS IN THE FIRST TEST,
COLUMBIAN SCHOOL

Scores	Visual	Non-Visual
55-59.....	1	2
50-54.....	7	2
45-49.....	8	7
40-44.....	3	8
35-39.....	5	4
30-34.....	4	4
25-29.....	1	2
20-24.....	1	1
Medians.....	45.6	42.5

higher scores, both median scores and averages. The average of the visual group was 43 and the non-visual group 41.5.

Eighteen of the pupils of the visual group made a better score than the ones who were matched with them, and twelve made a poorer score. The distribution of the scores in the second test is given in Table IX. The visual group again made the higher median score and a higher average. The average for the visual group is 22.33 and for the non-visual group 19.5. Since the maximum score is 25, this difference is significant. It must be somewhat discounted, however, on account of the difference in

TABLE IX
DISTRIBUTION OF SCORES OF THE VISUAL AND
NON-VISUAL GROUPS IN THE SECOND TEST,
COLUMBIAN SCHOOL

Scores	Visual	Non-Visual
25.....	3	.....
24.....	8	3
23.....	5	5
22.....	6	3
21.....	2	.....
20.....	1	6
19.....	.....	5
18.....	.....	3
17.....	.....	.....
16.....	1	1
15.....	1	.....
14.....	.....	.....
13.....	.....	1
12.....	.....	.....
11.....	.....	.....
10.....	.....	1
Medians.....	23.3	20.5

intelligence of the two groups. Twenty-two of the pupils in the visual group made better scores than those who were matched with them in the non-visual group, and only six made poorer scores.

The third test consisted in writing a composition on a trip along the Nile. The distribution of scores in this test is shown in Table X. The difference between the medians is slight, but the distribution of scores in the visual group is more closely grouped about the median than in the non-visual group. The

average score of the two groups is almost precisely the same, namely, 46.21 for the visual and 46.75 for the non-visual. Comparison of the scores for the matched pairs shows that three received the same mark, thirteen of the visual group received better marks than those paired with them, and only eight received poorer marks.

The results of the experiment in this school are contrasted with those in the Lingemann School in two ways. In the first place the visual group in the Columbian School made somewhat better scores, the only case in which their scores were not superior

TABLE X
DISTRIBUTION OF SCORES OF THE VISUAL AND
NON-VISUAL GROUPS IN THE COMPO-
SITION TEST, COLUMBIAN SCHOOL

Scores	Visual	Non-Visual
75-79.....	1	.....
70-74.....	.....	2
65-69.....	1	.....
60-64.....	3	2
55-59.....	2	3
50-54.....	5	3
45-49.....	5	4
40-44.....	5	3
35-39.....	1	3
30-34.....	1	4
Medians.....	50	47.5

being the average of the composition test. In the second place the relative performance of the visual and non-visual groups in the composition test is different in the two schools. In the Lingemann School the visual group showed their superiority in the composition test. In the Columbian School they showed their superiority in the verbal test. This difference makes doubtful any analysis of the results of the experiment in such a way as to indicate whether the visual instruction produces a particular kind of effect and the oral instruction another kind.

The divergence in the results in the two schools indicates further the necessity of making comparisons in a number of places,

and with a number of different teachers. The relative superiority of the visual and the non-visual methods depends in part upon the character of the particular visual devices which are used and in part upon the character of the mode of oral presentation which is compared with it.

On the whole, the results of the two experiments with the long projects indicate some superiority of the method in which visual materials were used in conjunction with oral discussion over oral instruction alone. This conclusion, of course, must be confined to the type of instruction which was given in this experiment and to the type of subject-matter which was here used. While the visual group indicated the superiority of the visual method the difference between the two methods was considerably less than has been found in other instances.

While it is not a part of the quantitative data of the experiment, it is worthy of remark that the teachers observed the classes who were taught by the purely oral methods to be restless and dissatisfied with the fact that they were not given the pictures as were the other groups. These classes had been accustomed to visual instruction. In weighing the advantages of visual methods, this fact of interest is to be taken into account.

On the whole, the experiment indicates that visual aids add to the effectiveness of instruction in geography. It does not indicate whether the various types of visual material—moving pictures, slides, stereographs, and models—differ among themselves in effectiveness.

CHAPTER III

THE RELATIVE EFFECTIVENESS OF SIX FORMS OF LESSON PRESENTATION: FILM, LECTURE, STILL PICTURE, FILM-LECTURE, FILM-MUSIC, AND READING, WITH PARTICULAR EMPHASIS ON THE SUITABILITY OF DIFFERENT TYPES OF MATERIAL FOR FILM PRESENTATION

HADDON W. JAMES

1. PRELIMINARY EXPERIMENT

In this experiment a comparison was made between the effectiveness of three motion-picture films and the presentation of the subject-matter of the films in the form of oral lectures. The films were obtained from the General Electric Co. Their titles are: *Queen of the Waves* (No. 27); *A Woolen Yarn* (No. 32); *Cuba, the Island of Sugar* (No. 25).

These films were shown to pupils of Grades III, IV, V, and VI of the University Elementary School, University of Iowa.

DIVISION OF THE GROUPS INTO SECTIONS FOR THE EXPERIMENTS

Each class was handled as a unit and divided into two sections for the purpose of having one section for visual instruction and one section as a check section. In dividing the groups the plan followed in the first experiment was to use the triple criteria of intelligence, teacher's estimates of general ability, and knowledge of the subject. Intelligence was determined by Binet-Simon individual tests, the teacher's estimate consisted in the judgment of the rank of the pupil in general ability, and the knowledge of the subject was determined by an objective test based upon material presented in the film. The individuals were ranked in all these criteria and then the combined rank was used to determine position in the class for this experiment. Thus if a student's

rank in intelligence was 4, his rank in general ability 3, and his rank in knowledge of subject was 5, his class rank would be 4. The third criterion, knowledge of subject, is believed to be a valid criterion for the following reasons: first, one measure of intelligence is acquired knowledge; second, if the pupil possesses a large amount of knowledge of a subject he must have some interest in that subject which the pupil with no knowledge, or a small amount of knowledge, does not have, and this will serve as a motive for learning. Nevertheless, for the second and third experiments this criterion was dropped, because of the fact that the variation in knowledge of the subject between parallel groups precluded the reversing of groups as a check device. In dividing the class groups into sections the rankings were made as described above and then the two sections were made by taking pupils of alternate rank.

METHOD OF INSTRUCTION FOR VISUAL GROUP

The four sections that were to receive visual instruction, half of each of the four classes divided by rank as previously described, were assembled in the instruction room. After securing the proper mental set for a high degree of attention, by appealing to the rivalry motive and problem attitude, the outline prepared for these groups was given verbatim. This was done to eliminate variation in the presentation and to produce conditions for this group that could be repeated by anyone. The film was then shown to the group immediately and the instruction was over.

METHOD OF INSTRUCTION FOR ORAL-LECTURE GROUP

The lecture for this group was made up as follows. The film was run through twice to get a general impression of the picture. It was then shown to a group of advanced students in education, most of whom had had considerable teaching experience. These students handed in sets of questions on the film. The film was then run through slowly, and an outline made of it while it was running. The film was stopped wherever necessary for writing. With this outline in hand the film was then run through six times for the purpose of making additions to the outline, checking

up on it, and fixating all of the details around the outline for the purpose of lecturing. With this apperceptive background, so to speak, the final test and outlines were made. It is believed that the foregoing method enables a representative outline to be made of the subject-matter in each film.

THE TESTS

Tests of the completion or multiple answer type were made up from the outline above described. These tests were given both before and after the film and the oral lessons. The results are presented in the form of the amount of gain which was made in these tests.

DETAILED ACCOUNT OF THE FILMS, OF THE LECTURES, AND OF THE TESTS

QUEEN OF THE WAVES

The catalogue description of this film is in part as follows:

A picture which tells the story of American navigation showing the Indian paddling across a stream on a log, constructing and floating a raft, and with stone axe building his dugout and bark canoe. . . . The treadmill-driven ferry and the great American achievement, Robert Fulton's steam-driven "Clermont" are shown in action as they appeared in their day. [Excerpts from General Electric Co. film catalogue.]

The instructions which were read to the film group before they saw the film were as follows:

If you came to a stream and nothing but a log was available, could you use it for getting across? Indians used this method, which was the simplest possible method of water navigation. Notice disadvantages of method in film, how the log sank under weight, speed of travel, etc. These disadvantages probably led to the raft which was made by fastening several logs together by weaving twigs around them. Notice that they can carry a load now without getting wet. Notice how the Indians pushed this with a pole. Disadvantages of this were that they couldn't use pole in deep water. Raft was heavy and couldn't carry across land.

The first improvement of the Indians over logs and log rafts was probably the shaping of a log. Thus the dugout came in. Probably called dugout because the side was dug out. Notice how flint hatchets were used in shaping the outside. Notice also how the inside was hollowed out by burning pitch and then scraping the rough bottom with a clam shell. Note

advantages: They could be paddled like canoes on Iowa River; they were more comfortable as the Indian could sit and paddle; he could also go into small places and over deep water. They had the disadvantage of being hard to make and heavy to carry.

In parts of the country where large pieces of birch bark could be gotten the Indians hit upon the idea of using this bark for sides of canoes. Thus we have the next improvement, the bark canoe which was the Indians' best achievement in boats. Notice how made. Frame of bent limbs probably hickory. These were bent and ends fastened together, then large slabs of bark fastened on. Next pitch was used over cracks to keep water out. Note advantages: They were light and could be carried across land, also not quite as hard work to make as dugout. Because of lightness and shape they could be paddled fast. Disadvantages: Propelled by hand. Small and couldn't make ocean journeys.

Advent of a new type of watercraft to America. Columbus came to this country in a sailing ship, the "Santa Maria." This was the first sailing ship that we have record of as ever being here. Thus sailing was introduced into this country. The advantages of these boats were: Carried many people; made ocean trips; wind did the work. Disadvantages: wind uncertain; size could not stand strong storms.

The first use of the paddle wheel was probably by the use of treadmill. The advantage of this type was that they didn't have to depend on wind; while the disadvantages were that they couldn't have much power nor take long trips. Used for ferries.

Using the principle of the paddle wheel the steam engine was used to turn the paddle wheel instead of the treadmill. Advantages were: Much power when wanted; engine didn't get tired. Examples: Robert Fulton perfected the "Clermont" in 1807 which was the first successful steamship. The "Clermont" brought in the epoch of the steamship which replaced the sailing ships.

Present advantages that we have in water navigation that did not exist in time of Columbus: Steamships—factories with organization, large machines to make ships.

The following outline comprises two of the eight sections of the outline which was made from the film and which was the basis of the lecture:

I. Fording rivers and streams with logs.

- A. If you came to a stream and nothing but a log was available, could you use it for getting across the stream?
- B. Indians used this method, which was the simplest method of water navigation, and first step to the boat.
 1. Indian would sit astride log and paddle with hands or small paddle.

- C. Discomforts of this method.
 - 1. Log would go under water.
 - 2. Couldn't carry much.
- II. The next step was to fasten several logs together into a raft.
 - A. How made: twigs bent and woven around logs to hold them together.
 - B. Advantages.
 - 1. Carrying loads—family, etc.
 - 2. Would not get wet.
 - C. What would the disadvantages be?
 - 1. Speed.
 - 2. Couldn't go into small and narrow places.
 - 3. Could use only in one place as they would be too heavy to carry.
 - D. Method of propelling raft.
 - 1. Poles—Couldn't use these in deep water.

The nature of the test may be judged from the first six items. There were seventeen items in all.

COPY OF PART OF TEST USED FOR THE EXPERIMENT EXERCISE

- a) The following animals are used for riding: Horse, lion, tiger, pony.
- b) The outside walls of this building are made of ———.

AMERICAN WATER NAVIGATION

- 1. The means of water travel used by the American Indian were: skiffs, rafts, gondolas, skis, logs, bark canoes, schooners, dugouts, barges. (4)
- 2. The simplest method of Indian water navigation was by ———. (3)
- 3. What was the forerunner of the steamship? (4)
- 4. The Indians' best achievement in boats was the ———. (4)
- 5. The dugouts were propelled by: oars, paddles, poles, sails, tread-mills. (3)
- 6. The tools used for shaping the dugout were: tomahawks, hatchets, knives, rocks, shells, flint hatchets, sharp stocks. (4)

The results of the three preliminary experiments will be presented together. A description of the two other films follows.

The catalogue description of this film is in part as follows:

A WOOLEN YARN

Film showing the wool industry, from the shearing of the sheep to the finished product. The various methods and apparatus employed in carding, spinning, and weaving, from the primitive Indians to our modern times. [Excerpt from General Electric Co. film catalogue.]

The instructions which were read to the film group before they saw the film were as follows:

In this film, notice how shearing was done by hand and machine clippers. Notice the carding by hand and machine. This was a tedious process upon currycomb principle. The following spinning method shown: Navajo, the old hand spinning wheel, then the improvement upon the hand spinning wheel, the foot-power wheel.

Notice the modern methods of making yarn: Washing of the fleeces, the carding, the washing after carding, the drawing, the combing. At this stage the wool is called "silver wool" and is now ready for spinning on machines. One girl now handles hundreds of spindles instead of one as was necessary by the old method.

Note methods of weaving: The Navajo method is the most primitive. The Colonial hand looms are shown. This principle has remained the same since Colonial days. Watch the other processes done by machinery, the dyeing, ironing, napping, measuring, bolting, wrapping, and shipping.

The following is part of the outline which was made from the film and which was the basis of the lecture:

- I. Process before entering factory.
 - A. Shearing.
 1. Formerly done by hand clippers.
 2. Oily work.
 3. Strength required.
 - B. Now done by machine clippers.
 1. Barber clippers look similar.
- II. Preparation for getting the wool ready for weaving.
 - A. Carding. (Drawing of hand card shown.)
 1. Hand carding—this was done by implements that worked on the principle of the currycomb; one in each hand.
 2. Machine carding—wool on larger roller being brushed by teeth.
 3. Modern way much more efficient.
 - B. Spinning before modern inventions came in.
 1. Most primitive way that of the Navajo Indian. Simply twisting around a stick.
 2. Old spinning wheel used by pilgrims.
 - a) One hand turned wheel and other twisted the wool.
 - b) This was the process of making yarn.
 - c) Something similar to twisting grass rope. Arms of women ached from this method of work as the wheel was turned one way and then the other.

3. First improvement on this spinning wheel was the foot-power wheel.
 - a) Worked by pedal.
 - b) Smaller wheel.
 - c) Both hands could be used in working with wool.
- C. Modern methods used in process of making yarn.
 1. Washing wool in the form of the fleeces.
 - a) Drags with teeth, taking wool through tank of water.
 2. Wool is carded. Leaves wool in forms of strips unwound.
 3. Wool is then washed after carding.
 4. Wool is then drawn to straighten fibers.
 - a) With this process two or more strands are united into one not any larger than the one previous to straightening.
 5. Combing—in this process four strands are united into one. In this the short fibers are removed; thus the short and long fibers can then be worked by themselves.
 6. At this stage the material is called “silver wool” and is ready for spinning. The power used now in machinery is not hand or foot power. Instead of a girl taking care of but one spindle she now takes care of several hundred with the machine as the machines do the twisting.

The nature of the test may be judged from the following items, of which there were thirteen in all.

COPY OF TEST USED FOR THE EXPERIMENT EXERCISE

- a) The (horse, lion, tiger, pony) are used for riding.
- b) The outside walls of this building are made of ———.

A WOOLEN YARN

1. The fleece is now generally removed from the sheep by ———, while in earlier times it was removed by ———. (3)
2. The first step after the wool has been clipped and washed is ———. (4)
3. The first improvement on the old spinning wheel was the ———. (3)
4. The wool is (is not) washed before carding. (2)
5. The wool is (is not) washed after carding. (2)
6. The main difference between the old spinning wheel and the modern machine method is (larger spindle used, no spindle used, several spindles used, hundreds of spindles used). (3)

CUBA, THE ISLAND OF SUGAR

In using this film the two reels were cut down into one and only those parts were used which bear directly upon the complete process of sugar manufacture from the field to the warehouse.

The instructions which were read to the film group before they saw the film were as follows:

You will see in this picture a plantation made from a forest wilderness. The trees are cut and burned to make land ready for plantation. Notice cutting and handling of cane. An expert can cut and load 12 tons per day. Notice methods of transporting cane to factory.

Watch the manufacturing processes. Watch what comes next and why. You will see the cars placed on the tilting table and contents dumped into a hopper. The crusher is the first process and it is here where the cane is torn into shreds. The cane is next ground in a grinding mill to pulp or bagasse. The grinding mills are composed of three rollers. These are driven by 200 H.-P. motor. From here the pulp goes to the bagasse burners where the juice is separated. The by-product is used for fuel for turbines. The juice is about 80 per cent of weight of cane.

We follow the juice from the juice wells first to the automatic scales. The juice is then settled in defecators, then the settlings are filtered in filter presses to get all of the juice. The juice then goes to evaporators where water is driven off by exhaust steam from the turbines. This is the first process of crystallization. The vacuum pans are the next crystallization process and the crystallizers further evaporate the material, but the last process in obtaining the sugar is in centrifugals where molasses is driven off.

After the sugar is completely manufactured samples have to be analyzed, then the sugar is bagged into 325 pound bags for shipment. From this one plantation shown 75,000 tons are obtained yearly.

The following is part of the outline which was made from the film and which was the basis of the lecture:

I. Making of the plantation.

A. 110,000 acres of forest in plantation.

1. Absolute wilderness.

B. 30,000 acres cleared.

1. Trees cut and burned.

C. Modern sugar mill erected in 1917.

1. Ten months after completing cane cut.

II. Handling of cane before entering factory.

A. Cutting.

1. Expert can cut and load 12 tons per day.
2. Cane worth about 85 cents per ton.
3. Loaded in cordwood fashion upon wagon drawn by oxen.

B. Transporting to the factory.

1. Hauled in ox wagons to plantation railroad.
2. Plantation owns seven locomotives.

III. Process of manufacturing.

A. Fireless steam engines used to haul cane to tilting table.

1. Engines work on thermos bottle principle. Will work about 4 hours on one charging of steam.

B. Cars of cane run on tilting table where they are tilted and cane dumped into hopper.

C. Conveyed to crusher through chute with traveling bottom.

1. Crusher consists of large rollers with teeth which shred the cane.

The nature of the test may be judged from the following items, from a total of fourteen.

COPY OF TEST USED FOR EXPERIMENT EXERCISE

- a) The (horse, lion, tiger, pony) are used for riding.
- b) The outside walls of this building are made of ———.

CUBA, THE ISLAND OF SUGAR

1. How was land made ready for making sugar cane plantation? (2)
2. The tilting table is used for ———. (2)
3. Cane first goes through the (chopper, grinding mill, crusher, juice well). (3)
4. The second stage in the manufacture of sugar is in the (chopper, grinding mill, crusher, juice well, defecator, vacuum pan). (3)
5. An expert cane cutter can gather about ——— of sugar cane per day. (2)
6. The grinding mill is composed of ——— driven by a———. (4)

RESULTS

The results of the tests are summarized in Table I.

SUMMARY OF RESULTS AND CONCLUSIONS

The striking result of the experiment is the sharp contrast between the relative effectiveness of the film and the oral lecture

in the case of the three films. These differences are too great to be accounted for by minor defects in technique. They must then be due to the character of the films or of the lectures.

Since the lectures were made up in the same way it seems probable that the differences in the relative effectiveness of the lectures and the films in the three cases are due in large part, at least, to the fact that the subject-matter of the first film was more largely within the range of the children's experience than was that of the other two films. The children were, in fact,

TABLE I

COMPARISON OF THE GAINS MADE BY THE FILM GROUPS AND THE LECTURE GROUPS

SUBJECT	GRADE	GAIN IN POINTS		PERCENTAGE OF SUPERIORITY	
		Film Group	Oral Group	Film Group	Oral Group
Queen of the Waves. .	{ III	6.6	7.6	.....	15.1
	{ IV	13.4	20.6	.....	53.7
	{ V	16.5	26.0	.....	57.5
	{ All	12.4	18.5	.....	49.2
A Woolen Yarn.	{ III	10.4	4.6	116.6	.....
	{ IV	12.1	9.1	32.9	.....
	{ V	14.5	7.5	93.5	.....
	{ VI	14.3	9.5	50.5	.....
	{ All	13.0	8.0	62.5	.....
Cuba, the Island of Sugar.	{ III	5.2	2.2	136.3	.....
	{ IV	12.5	5.6	126.7	.....
	{ V	11.5	6.3	82.5	.....
	{ VI	17.0	8.9	91.0	.....
	{ All	12.2	5.9	106.1	.....

so familiar with the objects that were portrayed in it that they could gain more information from verbal discussions of them than from their pictorial presentation. This, apparently, was not the case with the second and third films. The children had not had sufficient experience with the objects or processes portrayed in them to supply their imagination with material for thought.

The obvious conclusion is that oral discussion is effective when the pupils have had adequate previous acquaintance with

the objects or processes under discussion and that pictorial representation is effective when adequate previous experience has not been had.

CRITICISMS OF THE TECHNIQUE OF THESE PRELIMINARY EXPERIMENTS

From his experience with these early experiments the author derived certain criticisms of his technique. In the later experiments the technique was modified to meet these criticisms. The chief criticisms follow.

Changes in procedure were made in the course of the experiments. For example, one of the criteria for the division of the groups—the score on a preliminary test—was dropped.

The tests were not long enough and did not include a wide enough sampling of the subject-matter of the lessons. The tests, moreover, varied in length.

The pupils were stimulated by a strong spirit of rivalry between groups. This constituted an artificial stimulus.

The presentations were mixed. A few charts and pictures were used in the oral lessons and an oral introduction was used with the films.

2. OBJECTIVES AND GENERAL METHOD USED IN THE SERIES OF VISUAL EXPERIMENTS CONDUCTED IN THE DETROIT PUBLIC SCHOOLS

In general the objectives and method used in this series of experiments were very similar to those used in the series of experiments conducted in the University Elementary School. In several instances, however, the writer was enabled to improve on the former technique.

I. The primary objective or the problem of this series of experiments may be stated in a general way by saying that it is a study of the comparative effectiveness of motion pictures with other modes of presentation. The specific comparisons entailed in the series are as follows:

A. Effectiveness of various types of films:

The measuring unit in this series, as in the previous series, was oral presentation. A comparison is made, in each experiment of the series, of film presentation with lecture presentation. The relative effectiveness of the two forms for different types of material is contrasted.

B. Effectiveness of six types of presentation: film, film combined with lecture, film combined with music, oral presentation in lecture form, reading, and still picture in the form of slides. The foregoing six types are distributed by experiments as follows:

1. Two experiments comparing film, oral, and still-picture presentation. The groups were reversed as a check.
2. One experiment comparing film, oral, and film combined with lecture.
3. One experiment comparing film, oral, and reading presentation.
4. One experiment comparing film and film-music presentation.

C. Comparative effectiveness of film and oral presentation as motivation factor as measured by effect upon later reading lesson over similar material:

Two experiments used for this with groups reversed.

D. Study of comparative value of the foregoing presentations particularly with reference to still objects and moving objects.

1. The method used for making this comparison was by analysis of answers. This was done by tabulating answers for all questions separately, and noting any wide variation in number of correct answers to any one or more of the questions by any of the forms of presentation. The foregoing tabulation was made for each form of presentation and was tabulated for each experiment in the series.

II. The general method used in the series will be given under specific headings.

GROUP USED

In this series of experiments, 370 pupils, 190 of whom were girls and 180 boys, were used. This group comprised eight sections of eighth-grade pupils and two sections of ninth grade.

In this series of experiments the method of pairing of pupils was used to form comparable groups. The only objection that can be raised to this method is that it is wasteful in eliminating cases. This was taken care of by using large unpaired groups. In pairing the pupils the Thorndike-McCall Reading Test was used. The writer justifies the use of this test by the fact that it is a good

intelligence test as well as a reading test. In experimental procedure where partial correlations are used, this test partials out with the intelligence test. This indicates that the same thing is measured by both, or in other words, the Thorndike-McCall Reading Test in addition to measuring reading ability, is a measure of intelligence.

In using the results of this test, ~~the pupils were paired by the T-score.~~ This was done with the exception of three or four cases by identical T-score. Furthermore, boys were paired against boys, and girls against girls in nearly all cases. The tables showing pairing of pupils will be referred to under the description of each experiment.

CONTROL OF VARIABLES

TIME

The time element was held constant for each method of instruction in the respective experiments. This was done by carefully timing the film and then building the other lessons into this time. Instruction by all presentations was timed.

IDENTICAL MATERIAL FOR THE RESPECTIVE PRESENTATIONS

The following presentations were used in the various experiments: film alone, film with lecture, film with music, still picture, oral, and reading. The two presentations that are compared with each other in all the experiments are film alone and oral. Explanation will be given here of these two presentations, oral and film, that are common to all experiments and the other presentations will be described in the description of the respective experiments.

In forming an oral lesson that would be analogous to the film lesson the technique used in the University Experimental School series of experiments was improved somewhat. Instead of running the film over and over and taking notes on the film, preparation was made before running the film. An outline was either made or secured of all the titles and subtitles of the film. This was gone over with the teachers and then the film was run and re-run for the teachers, with this in their hands, and notes

built up around these subtitles. In the oral presentation these subtitles were used verbatim, and emphasized to correspond to the emphasis given in the film. The goal idea in these oral lessons was to make a lesson that was as nearly identical in material presented as possible. In the judgment of the writer the foregoing method seemed to allow less deviation between the two presentations than any other.

MOTIVE IN LEARNING

In this series no high degree of rivalry was produced between the different sections as in the case of the first series. The pupils were informed, however, that other groups would be receiving instruction upon the same material by other forms of presentation for the purpose of experimentation. It is the opinion of the writer, based upon observation of experimental work, that this is the only safe plan to follow under ordinary circumstances where more than one experimental lesson is given. If more than one experimental lesson were used, some of the sections would find out that an experiment was going on. How large a percentage of students would find this out, and what effect this would have, would be a variable, the importance of which we would have no means of determining. In this series, as above stated, the groups were informed by the teacher that another section of the class was going to be given a different presentation of the same material for the purpose of seeing which type of presentation was the better. No results were given and no forceful drive to rivalry was used. This technique seemed to place the students upon an equal footing without creating an artificial situation.

OBJECTIVE TESTING OF KNOWLEDGE

This is another place where the technique of the former experiments was improved. In the previous experiments the tests were objective so far as grading was concerned, but improvement was made in this series by giving a longer test, which gives a more adequate sampling of the pupils' knowledge. In this series of experiments, a twenty-question completion test and a

twenty-question "Yes-No" test were given in all cases. In scoring these tests no attempt to weight questions was made, but each question was scored one unit. In the completion test one point was given for each question answered correctly and in the "Yes-No" test the usual procedure of scoring was used, that of rights minus wrongs.

A further safeguard which was used was that the completion test was always given and collected before the "Yes-No" test was handed out. This eliminated the possibility of the "Yes-No" test suggesting answers for the completion test. In scoring the test, keys were used, and one point was given for each question that was entirely correct.

EXPRESSION OF RESULTS

In this series of experiments the findings are given for both the unpaired groups and for the groups after pairing. For the paired groups, the results were thrown into a distribution table and the true mean and standard deviation worked out. The difference is also expressed in percentage. To determine the significance of the difference in the mean score of the presentations a McCall experimental coefficient was worked out and translated into chances.¹

Following is a copy of the formula used for deriving the experimental coefficient. It is not the exact form given in McCall but is a compilation of several formulas:

$$\text{Exper. Coeff.} = \frac{\text{Mean of distribution No. 1 minus mean of distribution No. 2}}{2.78 \times \sqrt{\left(\frac{\text{Stan. Dev. Dis. No. 1}}{\sqrt{\text{No. cases Dis. No. 1}}} \right)^2 \text{ plus } \left(\frac{\text{Stan. Dev. Dis. No. 2}}{\sqrt{\text{No. cases Dis. No. 2}}} \right)^2}}$$

From the experimental coefficient found by the application of the foregoing formula, the reliability was expressed in terms of chance by transmutation from Table II.

In addition to the foregoing measures of comparison, tabulation was made by questions showing number of correct answers to each question by respective presentations. This was done for

¹ William A. McCall, *How to Measure in Education*. Macmillan Company.

the purpose of answering the objective: What is the comparative effect of the different presentations with regard to moving objects and still objects?¹

TABLE II

THE TRANSMUTATION OF EXPERIMENTAL COEFFICIENTS
INTO CHANCES

Experimental Coefficient	Approximate Chances
.1	1.6 to 1
.2	2.5 to 1
.3	3.9 to 1
.4	6.5 to 1
.5	11 to 1
.6	20 to 1
.7	38 to 1
.8	75 to 1
.9	160 to 1
1.0	369 to 1
1.1	930 to 1
1.2	2,350 to 1
1.3	6,700 to 1
1.4	20,000 to 1
1.5	67,000 to 1

RELIABILITY OF RESULTS

The procedure used to determine reliability was to correlate the completion-test scores with the scores of the "Yes-No" test by the Pearson Product moment formula² and to apply Brown's³ formula for reliability to this correlation.

Following are copies of the two formulas mentioned:

PEARSON PRODUCT MOMENT

$$r = \frac{\frac{\sum xy}{n} - Cx Cy}{\sigma x \sigma y}$$

¹ The result of this analysis is omitted from this condensed report.

² Harold O. Rugg, *Statistical Methods Applied to Education*. Houghton Mifflin Company.

³ Harold O. Rugg, *Statistical Methods Applied to Educational Testing*. *The Twenty-first Yearbook of the National Society for the Study of Education*. Public School Publishing Company.

BROWN RELIABILITY FORMULA

$$\text{Reliability} = \frac{nr}{1 + (n-1)r}$$

The foregoing formulas were applied to all tests in all of the experiments.

3. DESCRIPTION OF THE FILMS USED IN THE MAIN EXPERIMENTS AND OF THE METHODS OF PRESENTATION WHICH WERE COMPARED WITH THEM

In order to bring this report within the space limits which are set for it, the description of the films and of the other methods of presentation is brought together in this section, and the results are collected and presented together in the following section.

EXPERIMENT WITH THE FILM, "YELLOWSTONE PARK"

In this experiment eight sections of eighth-grade pupils were used, and three forms of presentation were tested. The forms tested were film, still-picture presentation in the form of stereopticon slides, and oral or lecture. Throughout the description of this series the words oral and lecture are used interchangeably.

In the description of this experiment it is only necessary to speak of the comparableness of the still-picture presentation with the film presentation, since the comparableness of the lecture and film presentation is described under the chapter on objectives and general method of this series. In order to get a still-picture presentation that is comparable to the film presentation, the film was first analyzed and note taken of all the different scenes shown in it. It was found that thirty-five different views were shown, such as Mammoth Geyser, Old Faithful Geyser, etc. Of these thirty-five, it was possible to match the identical scene with a slide picture in all but three cases. These three views were The Hoodoos or Old Lava Flows, Giantess Geyser, and Obsidian Cliff. In making out the questions care was taken to exclude material bearing on these scenes. In keeping the time constant, the slides were shown thirty seconds each, which made the total time for the presentation sixteen minutes. The motion

picture projector was regulated so that the time occupied for the film presentation was the same. At the presentation of each still picture the class teacher announced the view by giving the appropriate subtitle as it appeared in the film presentation.

The character of the film and of the tests may be judged from the following specimens.

SAMPLING FROM TEACHERS' OUTLINE UPON WHICH LECTURE
WAS BASED

YELLOWSTONE NATIONAL PARK

(The following subtitles are exactly as they appear upon the film)

The Yellowstone Park was made a national park in 1872. It is a land of hot springs and geysers. Over the gateway is this inscription, "For the Benefit and Enjoyment of the People."

The park is a plateau built up by lava deposits surrounded by mountains.

The high mountains of the continental divide form a rim about the east valleys.

The grassy valleys have some trees and shrubs.

The lodgepole, fir, spruce, balsam, and Douglas fir are the trees along the streams.

The forests shelter many wild animals.

The friendly bear is common.

The brown bear, unlike the grizzly, is at home in the trees.

Beavers build their home in the streams.

The eagle nests among the highest mountain crags.

SAMPLING FROM THE TWENTY-QUESTION COMPLETION TEST USED

Name ————

Grade and Section ————

Example: The outside walls of this building are made of ———.

YELLOWSTONE PARK

1. Lone Star is the name given to a ———.
2. Heat is given to the water in geyser by ———.
3. The Continental Divide is formed of ———.
4. Two tourist hotels are ——— and ———.
5. The ——— bowl gets its name from its shape.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name ————

Grade and Section ————

Example: "Yes-No." John is a boy's name.

YELLOWSTONE PARK

1. Is the water in geysers heated from the rocks? Yes-No.
2. Is Old Faithful the name given to a hot spring? Yes-No.
3. Is Cleopatra the name given to a Terrace? Yes-No.
4. Are very good accommodations furnished tourists? Yes-No.
5. Is Liberty Cap a famous terrace? Yes-No.

EXPERIMENT WITH THE FILM, "TOADS"

In this experiment eight sections of eighth-grade pupils were used, and three forms of presentation were tested. The forms tested were lecture, film, and film combined with lecture.

The same plan was used in this experiment as in the previous experiment to keep the paired groups as large as possible, namely, two sections of lecture presentation were paired against two sections of film presentation and two sections of film-lecture presentation were paired against a different two sections of film presentation.

In regard to the comparableness of the presentations there is not much need of explanation here. The comparableness of the film and lecture as previously mentioned is described in the general method of the series, and the film-lecture presentation is obviously comparable since the lecture is merely an oral addition to the film while the film is being shown. The time for all presentations was fourteen minutes.

SAMPLING FROM TEACHERS' OUTLINE UPON WHICH LECTURE
WAS BASED

TOADS

Outline of Contents

(Subtitles Italicized)

Tree and garden toads frequent ponds and sluggish creeks in the early spring.

Picture shows an ideal pond.

A true harbinger of spring is the toad with his inflated throat, singing his mating song.

Shows a hyla toad singing.

The hyla or tree toad lays her eggs in a gelatin mass usually attached to sunken branches and reeds.

Picture of a mass of hyla eggs on a twig.

The common garden toad lays her eggs in gelatin string in shallow water.

Toad eggs laid in long strands on a bed of pebbles.

A microscopic picture of the eggs in the string of gelatin. They are scarcely bigger than pinheads.

Micro-photograph of the eggs within the gelatin.

In a few days the tiny eggs began to develop into tadpoles.

All stages in the development of the eggs are shown.

When first hatched, the tadpoles are nourished by the gelatin surrounding them.

Picture of tadpoles clinging to the remains of the gelatin case.

SAMPLING FROM THE TWENTY-QUESTION COMPLETION TEST USED

Name ————

Grade and Section ————

Example: This building is made of ————

TOADS

1. At the first the tadpole breathes through ———.
2. The ——— toad has cup-shaped toes enabling it to cling to glass.
3. The tree toad attaches its eggs ——— branches.
4. Toad eggs are about the size of ———.
5. The toad drinks through its ———.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name ————

Grade and Section ————

Example: Yes-No. Is John a boy's name?

TOADS

1. Do toads drink through their skin? Yes-No.
2. Are the toads' eyes sunken? Yes-No.
3. Is the toad entirely defenseless against enemies? Yes-No.
4. Does the common garden toad lay its eggs under water? Yes-No.
5. Does the toad wink his eyes the same way we do? Yes-No.

EXPERIMENT WITH THE FILM, "LUMBERING IN THE NORTH WOODS"

In this experiment eight sections of eighth-grade pupils were used and four forms of presentation were tested. The forms tested were film, lecture, still picture, and film-music.

In this experiment the size of the groups was sacrificed somewhat in order to get four comparable groups. Four groups were used, in which the largest average variation was 1.6 points

on the Thorndike-McCall Test. The film presentation was again made the constant of comparison, all other forms being directly compared with this form. In this experiment there are two types of presentations not previously discussed as to comparableness. They are the film-music presentation and the still-picture presentation as worked out in this experiment.

In regard to film-music presentation, the objective in making this part of the experiment was to find out what emotional effect musical accompaniment has upon the learning process. The two presentations are comparable since the film is common to both presentations, the only difference in the two being that one has the addition of musical accompaniment. This film was used because of the fact that it lent itself admirably to musical accompaniment. There was plenty of chance for musical setting and variation, such as the crash of falling trees, the rippling of water, the sawing of wood, the pulling of sleighs over the snow, and various other opportunities for musical variation in accompaniment. The accompaniment used was piano music; some of the pieces were "Jingle Bells," "Vivacity," "Run, Run, Run," "The Shepherd Boy," "The Wood Violet," and others.

The still-picture presentation, as worked out in this experiment, seems to the writer to be about as comparable in identity of subject-matter with the film presentation as can be obtained. In this presentation, frames representing each scene were cut from the film along with a frame of each subtitle. These were cemented together in the same order as the film presentation.

This process gave a finished strip of film containing title, subtitles, and a frame of each scene in the picture in exactly the same order as the film. This strip of film containing thirty-three titles and thirty-six scenic views was shown in a projector that allowed moving the film a frame at a time. In giving this presentation each subtitle and scene was timed in the film presentation, and in the still-picture presentation the titles and pictures were allowed to stay on the same length of time as had been the case in the film presentation. The total time for the scenes was approximately nine minutes and approximately five

minutes for the titles. This time of fourteen minutes was the time used in all forms of presentation.

SAMPLING FROM TEACHERS' OUTLINE UPON WHICH LECTURE
WAS BASED

LUMBERING IN THE NORTH WOODS

(The following subtitles are exactly as they appear upon the film.)

The forest supplies the raw material for many industries.

Houses, furniture, boxes, fuel, railroad ties, telephone poles, and paper are only a few uses of wood.

The United States uses more wood per capita than any other country.

We are the richest in useful forests.

Our different forests are shown on the map. We will see how trees are changed to lumber in the forests of the Great Lakes region.

(Animated forest map of the United States.)

Summer time in a northern forest of pine and hard woods.

Selecting the site for the lumber camp.

The log huts are built and when the snow falls the work begins.

In the northern forests lumbering is done in the winter. In felling the trees, one side is notched and the saw started on the opposite side. The notch directs the fall of the tree and prevents the splintering of the timber.

As soon as the tree falls the brush and large branches are removed.

The tree is cut into logs by hand sawing.

A special motor saw does this hard work more quickly.

SAMPLING FROM THE TWENTY-QUESTION COMPLETION TEST USED

Name ————

Grade and Section ————

Example: This building is made of ———.

LUMBERING IN THE NORTH WOODS

1. Another name for log slide is ———.
2. The ——— moves a large load of logs.
3. The United States uses more wood ——— than any other country.
4. The northern woods are more than ——— removed.
5. Green timber is dried and seasoned in ——— heated ———.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name ————

Grade and Section ————

Example: Yes-No. Is John a boy's name?

LUMBERING IN THE NORTHWEST

1. Is the United States the third richest country in useful forests? Yes-No.
2. Is winter the busiest time in northern forests? Yes-No.
3. Are rollers used in lumber camps? Yes-No.
4. Are the large branches cut from the tree before it is felled? Yes-No.
5. Are trees still sawed into logs by hand? Yes-No.

EXPERIMENT WITH THE FILM, "THE MOSQUITO"

In this experiment four sections of pupils were used, two of eighth grade and two of ninth. Two forms of presentation, film and lecture, were used and these were tested both for presentation and for motivation effects upon a later reading lesson.

Inasmuch as the comparableness of the two forms of presentation has been previously discussed, we may proceed to take up at once the explanation of the second part of the experiment. Immediately after the film or oral presentation had been given, a reading lesson on mosquitoes was given to the students. This consisted of the material in the regular class text on general science,¹ a specimen of which is given in this chapter. A twenty-question completion test and a twenty-question "Yes-No" test was then given over this reading lesson.

The length of time required for the preliminary presentation lecture or film was thirteen minutes. The time given to the reading was fifteen minutes.

SAMPLING FROM TEACHERS' OUTLINE UPON WHICH LECTURE
WAS BASED

THE MOSQUITO

Outline of Contents

(Subtitles Italicized)

All the stages in the mosquito's life-history.

Ponds and puddles make good breeding places for mosquitoes.

Views of three typical mosquito ponds.

The female mosquito lays from one to two hundred torpedo-shaped eggs, glued together to form a little raft. These float in the water, points downward.

Microscopic picture shows a row of eggs.

¹ Gilbert H. Trafton, *Science of Home and Community*. Macmillan Company.

The baby mosquito in hatching "wiggles out" from the pointed end of the egg into the water. The baby mosquito just hatched.

A microscopic picture of the baby mosquito beside the egg from which it has hatched.

Note the heart pulsations in the body of a baby mosquito.

Picture of the same baby mosquito. A stronger light is passed through the body to show up the internal organs.

Panoramic microscopic view of a baby mosquito's tube through which it breathes, its four swimmerettes, abdomen, thorax, and head.

The same larva is used as seen in the preceding pictures; it is scarcely visible to the naked eye.

The larva or "wriggle-tail" of the mosquito.

A close view of the entire mosquito is shown as it hangs at the surface of the water.

The larva feeds on microscopic plant and animal life.

The larva is seen eating about a bunch of algae.

SAMPLING FROM THE TWENTY-QUESTION COMPLETION TEST USED

Name ————

Grade and Section ————

Example: This building is made of ———.

THE MOSQUITO

1. The ——— takes no nourishment.
2. The ——— of the mosquito are fringed with spicules.
3. The baby mosquito wriggles out of the ——— of the egg.
4. The ——— mosquito looks the most ferocious.
5. Oil kills the mosquito larva in about ———.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name ————

Grade and Section ————

Example: Yes-No. Is John a boy's name?

THE MOSQUITO

1. Does the larva molt or shed its skin four times? Yes-No.
2. Is the pupa hatched direct from the egg? Yes-No.
3. Does the tumbler take nourishment? Yes-No.
4. Do the mosquito's eggs float in raft on surface of water? Yes-No.
5. Are the spicules on the wing of the mosquito? Yes-No.

SAMPLING FROM READING LESSON

I. HARM DONE BY MOSQUITOES

Mosquitoes and malaria.—Malaria is caused by a microscopic animal which lives in the blood. These parasites enter the red blood corpuscles and grow till they occupy nearly the whole space, and then divide into a number of little spores, which, as the wall of the corpuscle bursts, pass out into the blood. It is at this stage that the chills which characterize malaria occur. These spores enter other corpuscles and the process is repeated.

Some of these spores undergo a different kind of development. When these are sucked up with the blood by a malarial mosquito, they pass through certain stages of development in the body of the mosquito, and at the end of little more than a week produce spores of another kind, some of which find their way into the salivary glands. When the insect bites a person these spores are introduced into the blood of this person together with the fluid from the salivary glands, and begin the process of growth which brings on malaria. Thus it is seen that the relation of the parasite to the mosquito and human beings is a very vital one. It cannot undergo its complete development in either one alone, so that for the continuation of the disease both human beings and this mosquito are essential, one of which must be infected with the parasite.

It has been estimated that the annual financial loss in this country due to the agency of mosquitoes in carrying malaria is \$100,000,000. The United States Department of Agriculture has made a study of the economic loss sustained on the southern plantations on account of the sickness and deaths due to malaria. These losses are of two kinds, those due to loss in time and those due to reduced efficiency, at the season of the year when labor is most needed to harvest the crops. On one plantation it was estimated that \$6,500 was lost in one year, \$2,200 from actual sickness, and \$4,300 from inefficiency due to malaria.

This reading matter comprised about 2,700 words. It requires a reading rate of about three words a second to read it in fifteen minutes.

SAMPLING FROM THE TWENTY-QUESTION COMPLETION TEST USED

Date ———

Name ———

Grade and Section ———

THE MOSQUITO

1. Mosquitoes are ——— because some kinds carry ———.
2. Two diseases carried by certain kinds of mosquitoes are ——— and ———.

3. Mosquitoes breed in _____ places.
4. The northern mosquito is called _____.
5. The four stages in the life-history of a mosquito are _____, _____, _____, and _____.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name _____

Grade and Section _____

THE MOSQUITO

1. Is it true that all mosquitoes are harmless? Yes-No.
2. Some kinds carry germs of disease. Yes-No.
3. Mosquitoes breed in swampy places. Yes-No.
4. There is no financial loss due to the mosquito. Yes-No.
5. All mosquitoes pass through the four stages during the life-history. Yes-No.

EXPERIMENT WITH THE FILM, "THROUGH LIFE'S WINDOW"

The aim and procedure in this experiment were the same as those in the experiment with the preceding film. The same groups of children were used, but the film and the lecture groups were reversed.

SAMPLING FROM TEACHERS' OUTLINE UPON WHICH LECTURE WAS BASED

THROUGH LIFE'S WINDOW

Your eye is really a photographic camera. We are going to show you a picture.

It will stay on the screen one-sixteenth of a second. Try to see it.

Flash of a capital "F" (shown by picture).

Did you catch it? Well, try again. This time it will stay one-eighth part of a second.

Ready.

Flash of two "Q's."

That was it? If you did not get it, perhaps you will get this one, in one quarter of a second.

Flash of four "D's."

Yes, it was a "D." It took you one-quarter of a second to see it, but it took the camera only 1/1000 part of a second to see this.

Motorcycle rider shown going at full speed.

The eye and the camera work very much in the same way. Compare the eyelids—Girl's eyelids.

—With a single type of camera shutter that lets the light in for just so long a time. Camera shutter working.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name ————

Grade and Section ————

THROUGH LIFE'S WINDOW

1. Is the crystalline in the back part of the eye? Yes-No.
2. Is the cornea very soft? Yes-No.
3. Is light deflected upon entering water? Yes-No.
4. Is it false to attribute headaches to eye trouble? Yes-No.
5. Does the crystalline regulate accommodation? Yes-No.

SAMPLING FROM READING LESSON

IMPORTANCE OF OUR EYES

How we see.—One of the saddest results of the world-war is seen in a hospital where men blinded by gas or other causes grope their way around in somber darkness. How we pity them! The loss of sight would be one of the most terrible things that could happen to us. Then why should we abuse these delicate organs we call the eyes? The daytime is not long enough for us, so we provide ourselves with artificial light, and keep our eyes at work part of the night. We read fine print in the light, and injure our eyes in a hundred ways. Our eyes are of so much importance to us that it seems wise to devote an entire chapter to them and their care.

Lenses and what they do.—We have all tried to set fire to a pile of leaves or paper with a burning glass. An ordinary reading-glass found sometimes on the library table is a common example of a simple lens. If we look at it in cross-section, we find that it bulges outward in the middle in both directions. We call such a lens *double convex*. If we hold such a lens so that the sun shines through it, and move a piece of paper toward or away from it, one place will be found where only a tiny spot will be lighted, but this will be extremely bright, and enough heat may be concentrated to set the paper on fire. This point at which the sun's rays have been brought together is called the *focus*. When light passes through the air to the glass, it moves in parallel rays, but the glass bends the rays together at one point. This point is called the *principal focus* of the lens, and the distance from that point to the center of the lens is called the *focal length*. You can easily measure the focal length of a lens by this method.

This entire passage is about as long as that on the mosquito.

SAMPLING FROM THE TWENTY-QUESTION COMPLETION TEST USED

Name ————

Grade and Section ————

EYE AND CAMERA

1. The eye and the ——— have parts which function very much alike.
2. Light rays travel in ——— lines.
3. When rays of light pass through a lens, they are bent so that they are brought together at one point called the ———.
4. The eye as well as the camera has a ——— which brings the rays of light to a focus.
5. The eye is a ——— organ and has been placed in a bony socket for ———.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name ———

Grade and Section ———

EYE AND CAMERA

1. Are the eye and camera in some respects similar? Yes-No.
2. Do light rays travel in parallel lines? Yes-No.
3. Is it true that images do not have to fall upon the retina in order for us to see clearly? Yes-No.
4. The eye and camera have lenses for similar purposes. Yes-No.
5. All lenses focus the light rays at the same point. Yes-No.

EXPERIMENT WITH THE FILM, "WASTE DISPOSAL IN CITIES"

In this experiment four sections of eighth-grade pupils were used and three forms of presentation were tested. The forms tested were lecture, film, and reading.

The plan of using the film group as a constant for comparison was followed in this case. A lecture section was paired with a film section, and a reading section was paired against a different film section.

The comparableness of the film and lecture presentation is the same as for the rest of the series of experiments. The reading lesson was based upon the titles and subtitles of the film. A copy of the exact reading lesson is given in the latter part of this chapter. In order to emphasize the titles comparable to the emphasis in the film and lecture lesson, the titles were capitalized and underlined. The time for all presentation was held constant, namely fourteen minutes for all forms. In this reading lesson the pupils were working under a time limit. This is brought about by the teacher informing them that they were to compete with the film section and that they would have the same amount of time that it took to run the film.

SAMPLING FROM TEACHERS' OUTLINE UPON WHICH LECTURE WAS BASED

WASTE DISPOSAL IN CITIES

Outline of Contents

(Subtitles Italicized)

Waste comes from the house.

A picture of a typical house.

From the sink, washbowl, water-closet, bathtub, refrigerator, and washtub.

An architect's drawing of a house in cross-section, showing how the plumbing is installed.

It flows to the street sewer.

A picture of three buildings taken from above, followed by a diagram showing how the house sewers enter the street sewer.

From street sewers to collecting sewer.

A picture of a section of a Boston shore front, followed by a diagram showing the street sewers running into the intercepting sewer.

Boston sewage is collected in tanks at Moon Island. . . .

A picture of the collecting tanks and gate house at Moon Island.

. . . and stored until the tide begins to go out, when it is discharged.

A picture of the outlet pipe through which the sewage begins to flow, pouring out in a torrent which the eye can follow far out into the bay.

The city of Brockton is not near the water.

Its sewage, therefore, must first flow down to a pumping station.

A picture looking down on the pumping station, which is at the lowest point in the city.

SAMPLING FROM READING ASSIGNMENT

WASTE DISPOSAL IN CITIES

1. *Waste comes from the house.*

In present-day conditions, with modern water systems, each family has a large amount of sewage to dispose of daily.

2. *From the sink, washbowl, water-closet, bathtub, refrigerator, and washtub.*

The drains from these various conveniences are brought into one central pipe in the house. A chart of this system would look something like the branches of a tree running down into the trunk.

3. *It flows to the street sewer.*

This main sewer pipe from the house enters the street sewer into which all the houses on the street pour their contents.

4. *From street sewers to collecting sewer.*

The street sewers enter the collecting sewer similar to the house sewers entering the street sewer.

5. *Boston sewage is collected in tanks at Moon Island. . . .*

The collecting sewers of Boston carry the city's sewage to large tanks at Moon Island.

6. . . . *and stored until the tide begins to go out, when it is discharged.*

By doing this, the tide carries the sewage out with it.

7. *The city of Brockton is not near the water.*

8. *Its sewage, therefore, must first flow down to a pumping station.*

This station is located in the lowest part of the city where the collecting sewers can carry it by gravity.

The amount of reading material in the entire selection is about one-third of that which was used in the follow-up reading in the two preceding experiments. The reading passage in this experiment, therefore, was not as full or detailed as it might have been, and this fact is probably to the disadvantage of the reading assignment.

SAMPLING FROM THE TWENTY-QUESTION COMPLETION TEST USED

Name _____

Grade and Section _____

Example: This building is made of _____.

WASTE DISPOSAL IN CITIES

Boston System

1. Boston sewage is collected in tanks at _____.
2. The sewage from a house first goes to the _____.
3. The Boston sewage is discharged when the _____.
4. The street sewers run into the _____.

Brockton System

5. The purification plant is _____ from the city.
6. Brockton sewage is gotten to the purification plant by _____.
7. The sewage is first sprayed upon a _____.

SAMPLING FROM THE TWENTY-QUESTION "YES-NO" TEST USED

Name _____

Grade and Section _____

Example: Yes-No. John is a boy's name.

WASTE DISPOSAL IN CITIES

Boston System

1. Do house sewers run directly into the collecting sewer? Yes-No.
2. Is Boston sewage collected in tanks at Moon Island? Yes-No.
3. Is sewage discharged when tide is coming in? Yes-No.
4. Do street sewers run into collecting sewers? Yes-No.

Brockton System

5. Is Brockton on the waterside? Yes-No.
6. Are gasoline engines used to pump the sewage? Yes-No.
7. Is sewage system of Brockton the same as that of Boston? Yes-No.

4. RESULTS OF THE DETROIT EXPERIMENTS

The results of the various comparisons which were made in the main experiments are presented in a series of tables and charts.

In Table III are given the chief details of the results which bear upon the relative effectiveness of the film presentation and the lecture.

The comparison of the film and lecture is shown graphically in Figures 1 and 2. In order to make the comparison of the scores readier, the scores in the completion and the "Yes-No"

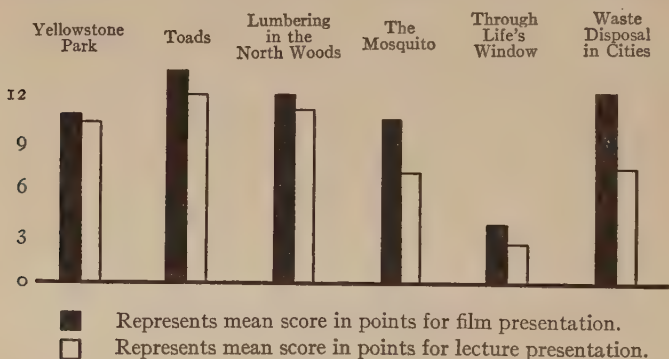


FIG. 1.—Effectiveness of various types of films as measured by oral presentation. Scale drawing of true means, for completion tests.

tests have been combined, and combined totals are represented graphically in Figure 3. The summation of the scores in the two tests is justified by the fact that the scores in the pre-tests are very low and that the standard deviations of the two tests are practically equal.

Figure 3 makes it possible to compare the results in the case of the paired and the unpaired sections. Since some comparisons have been made using unpaired sections, it is important to know whether the scores of the unpaired sections run parallel with the

TABLE III
COMPARISON OF FILM AND LECTURE PRESENTATIONS

NAME OF FILM	COMPLETION TEST						"Yes-No" Test				RELIABILITY OF TESTS
	Gain in Points		Superiority in Percentage		Exper. Coeff.		Gain in Points		Superiority in Percentage		Exper. Coeff.*
	Film	Lect.	Film	Lect.			Film	Lect.	Film	Lect.	
Yellowstone Park.....	10.5	9.53	10.3	.....	0.784		13.23	13.49	.....	1.9	.13
Toads.....	13.14	11.93	10.1	.....	0.59		14.91	15.33	.....	2.8	.775
Lumbering in North Woods.....	11.89	10.85	9.5	.....	0.559		13.72	10.5	.....	.....	.38
Mosquito.....	9.54	6.86	39.0	.....	1.97		11.92	9.38	14.8	.....	.678
Through Life's Window.....	3.66	2.34	56.0	.....	1.05		6.94	4.48	55.0	.....	.621
Waste Disposal in Cities.....	11.78	7.12	65.4	.....	2.8		15.22	12.69	19.9	.....	.745
											.828

* See Table II on p. 205 for the interpretation of these coefficients.

results of the paired sections. The figure reveals the fact that these results were remarkably parallel. This striking parallelism may be due to the system of class-sectioning used in the Detroit Public Schools. The parallelism of the two sets of averages greatly enhances the value of the comparisons drawn from the unpaired sections.

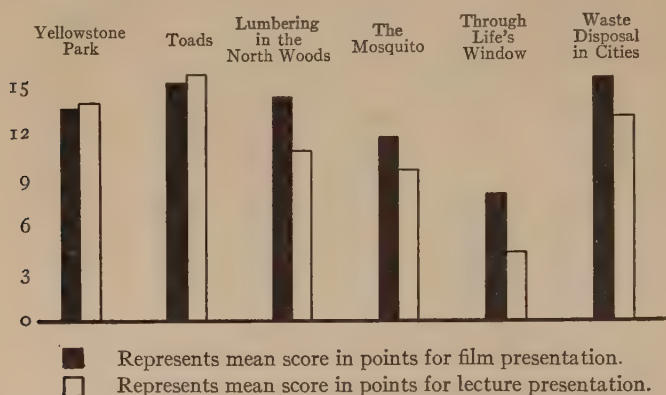


FIG. 2.—Effectiveness of various types of films as measured by oral presentation. Scale drawing of true means, for “Yes-No” tests.

It is evident from this figure that under the conditions of these experiments there is a wide range in the value of the different films for teaching. The advantage of the film presentation in the *Yellowstone Park* and the *Toads* experiments is practically nothing, when the experimental coefficient is taken into account. On the other hand the experiment, *Waste Disposal in Cities*, shows a marked advantage in favor of the film presentation, and the other three experiments show varying degrees of effectiveness in favor of the film presentation.

The explanation of the difference in the effectiveness of the various films may perhaps be found by an analysis of their content. The outline of each of the film lessons is printed herein so that the reader may inspect them for himself. As it is a matter of subjective classification, no fine lines can be drawn, but it seems as if the principle is true which was pointed out in the first series of experiments, namely, that *when fundamental,*

concrete experience is lacking the more nearly we approximate the real experience in instruction, the more effectively is the lack supplied. Conversely, when the presentation deals with material that falls within the experience of the learner, a rearranging of the experience

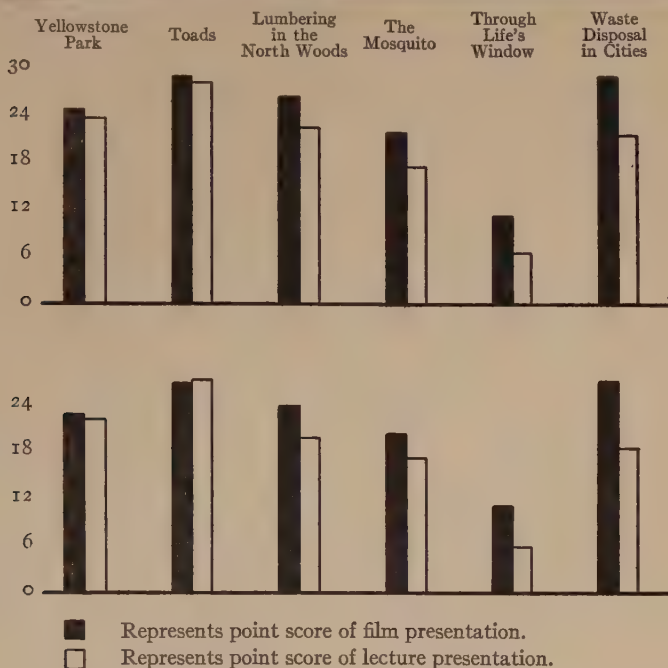


FIG. 3.—Effectiveness of various types of films as measured by oral presentation. Summation of results of completion and "Yes-No" tests.

can be secured advantageously through oral instruction. In speaking of experience in the foregoing principle, the writer would include not only identical experiences, but experiences of a similar nature to those embodied in the new material to be learned.

OTHER COMPARISONS

The comparison of the film with still pictures was made in the cases of the films *Yellowstone Park* and *Lumbering in the North Woods*. The results of the comparison are shown in Table IV and Figure 4.

TABLE IV—Continued

FILM AND FILM WITH MUSIC

NAME OF FILM	COMPLETION TEST					"Yes-No" TEST					RELIABILITY OF TESTS
	Gain in Points		Superiority in Percentage		Exper. Coeff.	Gain in Points		Superiority in Percentage		Exper. Coeff.	
	Film	Film-Music	Film	Film-Music		Film	Film-Music	Film	Film-Music		
Scores for Combined Group											
Lumbering in the North Woods....	11.89	12.19	.....	2.5	0.16	13.72	13.74	.....	0.1	.009	.767
	Scores for Boys										
	12.4	11.5	7.3	.....	.....	13.3	12.9	3.0	.....	.....	.....
	Scores for Girls										
	10.8	12.1	.....	12.0	.....	11.0	11.9	.....	8.1	.....	.....
COMPARISON OF SCORES ON FOLLOW-UP READING											
NAME OF FILM	COMPLETION TEST					"Yes-No" TEST					RELIABILITY OF TESTS
	Gain in Points		Superiority in Percentage		Exper. Coeff.	Gain in Points		Superiority in Percentage		Exper. Coeff.	
	Film	Lecture	Film	Lecture		Film	Lecture	Film	Lecture		
Mosquito.....	8.46	9.27	.....	14.0	0.68	11.6	12.54	.....	7.7	.367	.753
Through Life's Window.....	6.3	4.75	32.0	.....	0.901	11.51	8.73	32.0	.....	.909	.711

The comparison of the results of the film and the still picture presentations indicates the film is superior in both cases. As stated in the description of each of these experiments, the technique used in forming the still-picture lesson was different in the two experiments. The technique used in the experiment, *Lumbering in the North Woods*, gave the more exact reproduction of the film of the two. A further study using this latter technique in a series of experiments is needed.

In interpreting the results of this experiment, it should be kept in mind that the explanatory comments on the still pictures

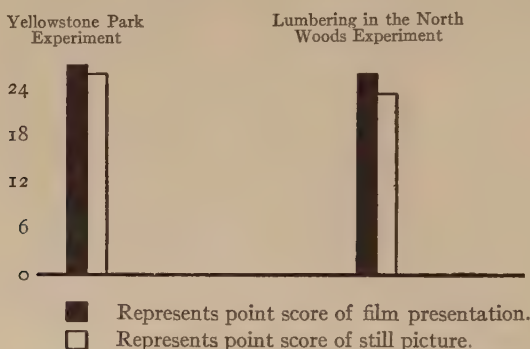


FIG. 4.—Comparison of the film and still picture. Summation of results of completion and "Yes-No" tests.

were given in subtitles which were shown alternately with the pictures, as in the case of the motion picture.

The comparison of the results of the film with a reading selection made up of the subtitles and some explanatory comments which were added to the subtitles is also shown in Table IV and Figure 5. It is evident that the film is decidedly superior in effectiveness to this type of reading matter.

The comparative effectiveness of the film, and the film with the addition of oral comment, is, so far as the results of the experiment with one film is an indication, practically the same. The superiority of the combination of film and lecture is so slight as to be negligible.

The addition of music to the film presentation, which was made in the case of the film, *Lumbering in the North Woods*, seems to affect boys and girls differently, if we can rely upon the results of one experiment as given in Table IV. The scores of the boys were lower in both tests, while those of the girls were higher. Taking the classes as a whole, the attention of the pupils seemed to be heightened by the music, but the rapt attention seemed to have little effect on the acquisition of information.

The comparison of the film and lecture as motivation for later reading of similar material was made in the case of the two

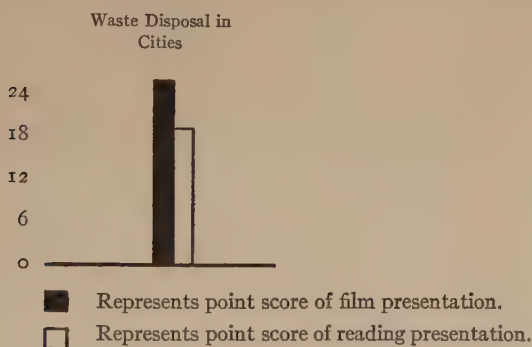


FIG. 5.—Comparison of the film and reading. Summation of results of completion and “Yes-No” tests.

films, *The Mosquito* and *Through Life's Window*. Table IV shows that there is conflict in the results of the two experiments. The experiment on *The Mosquito*, taking both the completion and the “Yes-No” tests into consideration, gives an average superiority on the reading lesson of 1.55 points in favor of the lecture section. The experiment *Through Life's Window*, again taking both tests into consideration, gives an average superiority in the reading-lesson scores of 5.33 points in favor of the film-presentation section. In addition to the larger point difference obtained in the second experiment, this difference is shown to be more significant by the experimental coefficients. The experimental coefficients of the differences in *The Mosquito* experiment

are .68 and .367. In the case of the experiment with the film, *Through Life's Window*, the coefficients are .901 and .909.

Taking all of the foregoing facts into consideration the film has proved to be more stimulating than the lecture presentation for these two lessons. The fact that there is a difference in the findings of the two lessons means that much more experimental evidence is needed on this topic. The writer is of the opinion that experimentation should be carried on for a series of lessons using several films and several reading lessons all of which are on the same general subject.

SUMMARY

1. In the preliminary experiment the oral lesson was superior to the film in one case and the film was superior in two cases.
2. In the main experiment the oral lesson was slightly inferior to the film in two cases and markedly inferior in three cases.
3. Still pictures alternated with subtitles were somewhat inferior to the film in two cases.
4. A reading text, made up of the subtitles of the film and of brief explanatory comments, was inferior to the film in one case.
5. Oral comment and music each appeared to add slightly to the effectiveness of a film.
6. The film proved to be a better introduction to a reading assignment in one case, and an oral introduction proved slightly better in another case.

CHAPTER IV

COMPARISON OF SIX MODES OF PRESENTATION OF THE SUBJECT-MATTER CONTAINED IN A FILM ON THE IRON AND STEEL INDUSTRY AND ONE ON LUMBERING IN THE NORTH WOODS

F. D. McCLUSKY AND H. Y. McCLUSKY

The geography teacher of today finds it a difficult task to develop in children a clear conception of the complexity of our modern methods of living. Such subjects as food, clothing, and shelter used to be devoid of their present intricacies. The modern child must be taught to view his shredded wheat, his shoes, his cap, his home, or his newspaper as the product of the labors of an army of workers scattered to the four corners of the world. It is obvious, then, that the geography teacher has as one task that of teaching the child the steps by which the product was evolved.

There are several methods by which the child could become acquainted with the series of events described, for example, in "The Story of a Grain of Wheat." (1) He could be taken on a journey which would carry him through each step in the process. (2) He could hear a competent observer tell the story. (3) He could read the story in books. (4) He could view a miniature set-up of the process in the form of a model exhibit. (5) He could look at and study still pictures illustrating the steps in the story. (6) He could view a moving-picture depicting the process. (7) He could be taught by any combination of these six methods.

It would appear that the moving-picture would be an effective method of teaching a sequence of events, such as those describing the "Story of a Grain of Wheat." The moving-picture is not only able to carry the observer in imagination from place to place in an instant, but it can also review the events of months in a

short space of time. By means of the moving-picture the teacher is able to present to the child a place or time sequence in a concrete manner. The presentation of processes such as have been mentioned is given in a number of films produced by various concerns, depicting the steps through which a particular raw product must go before it becomes a finished product. Two such films, each produced in the Ford Laboratories, were selected to test experimentally the effectiveness of teaching such a sequence by the film as compared with slides and prints. The titles of these reels were *Lumbering in the North Woods* and *Iron and Steel*.

The experimental technique used in this group of experiments was the same for each sub-experiment in the group; hence a description of a single procedure will suffice for the entire group.

PROBLEM

The purpose of these experiments was to compare the effectiveness of six methods of instruction in teaching the sequences in lumber and iron and steel: (1) The film unaccompanied by oral instruction; (2) the film accompanied by oral instruction during the showing of the film; (3) the slide with subtitles unaccompanied by oral instruction; (4) the slide with subtitles plus oral instruction; (5) the photographic print with subtitles unaccompanied by oral instructions; and (6) photographic print with subtitles plus oral instructions.

DESCRIPTION OF THE EXPERIMENT

I. SUBJECTS

Pupils from the fifth to eighth grades inclusive, in three schools, made up the personnel of the experimental group. The three schools were the North Doan and Mount Auburn Schools, of Cleveland, Ohio, and the Thomas Herzl School, of Chicago, Illinois. Comparable groups were chosen on a basis of intelligence test scores, age, and grade. The Illinois Intelligence Examination was used at Cleveland, and the Haggerty, Delta 2, Intelligence Test was used at Chicago. The pupils making up these groups were in attendance at schools where visual education

was being successfully carried forward, hence they were familiar with the technique of studying pictures.

2. TOPIC

The subject-matter of instruction in this group of experiments was based on the two films, *Lumbering in the North Woods* and *Iron and Steel*. The slides used in the slide instruction were made direct from the film in the Ford Laboratory and illustrated every step in each of the two processes. The prints used in the print instruction were made direct from the slide negatives and duplicated each slide. The subtitles used in the slide and print instruction were the same as those appearing in the film. Thus in the slide and print instruction, the sequence of the series of subtitles and pictures was the same as in the films.

3. PRESENTATION OF THE TOPIC

Two trial experiments were carried out at the Cleveland School of Education before the actual experimentation began at the North Doan School. The assistant principal of North Doan, Miss Anne Dubelin, observed one period to become familiar with the technique. Later the teacher from Mount Auburn, who was to instruct the oral groups, Mrs. Ethel Daus, observed the work of Miss Dubelin. At Chicago the teacher was prepared for the oral instruction by conferences with H. Y. McClusky who was in charge of the administration of these experiments in both cities. In each school the same teacher taught all groups.

The instructional period consisted of a four-minute presentation or exploration period by the teacher in which she asked questions of the pupils to develop their interest in the subject-matter to follow. A showing of the film or slides or prints followed. The total time for instruction was constant for each group.

1. The "film-no-talk" instruction consisted of a single projection of the reel.

2. The "film-talk" instruction consisted of a single projection of the reel during which the teacher and pupils carried on a

rapid-fire question-answer discussion of the picture. The pupils were free to comment on anything they did not understand.

3. The "slide-no-talk" instruction consisted of a single projection of the series of slides containing alternately pictures and subtitles. The time devoted to each subtitle and slide was the same to the second as that given to the corresponding subtitle or picture by the film. (The operator of the projector and stereopticon was the same for every group taught in the three schools. He had previously timed the scenes and subtitles of the film with a split-second stop watch and had a time chart and stop watch at hand to govern the projection of the slides. The only variation in time was the variation of the current which ran the motor of the moving-picture projector. This caused a change in the total time of 30 to 60 seconds from group to group.)

4. The "slide-talk" instruction consisted of a single projection of the series of slides, as in method No. 3, accompanied by a question-answer discussion of the pictures parallel to that of the "film-talk" instruction.

5. The "print-no-talk" instruction consisted of having the children study the series of pictures and subtitles. Each child had a set of mounted pictures in order and a booklet of subtitles. On a signal they turned over the pictures and booklet and studied the series just as they would a picture book.

6. The "print-talk" instruction consisted of the "print-no talk" instruction plus a question-answer discussion of the pictures parallel to that of the "film-talk" instruction.

The American projector was used for the film projection in the North Doan and Mount Auburn experiments, and a De Vry projector was used in the Chicago experiments. (A time schedule governing the time devoted to each subtitle and scene was made for each projector.) All projection was carried on in the same room in each school. These rooms were especially prepared for projection and the results were superior. A Bausch and Lomb Stereopticon was used at each school.

The total time for each instruction period at North Doan and Mount Auburn was nineteen minutes for lumber, and nineteen minutes for iron and steel. The total time for each

instruction period at Thomas Herzl, Chicago, was nineteen minutes for lumber and nineteen minutes for iron and steel.

The instruction given each group previous to each period of instruction follows.

EXPLORATION PERIOD PRECEDING THE REGULAR INSTRUCTION

I. LUMBERING IN THE NORTH WOODS

Instructor addressing class:

How many of you have seen a forest? Where? Where do you think the greatest forests are? In what part of this country? What are the forests good for? What do they do with the trees? Have you ever seen a lumber yard? Where? Where did the lumber come from? Yes, the lumbermen saw those logs up into boards and ship them all over the country. Are the forests very important? Why? What things are made out of wood? Name some of them [here the instructor waits for the class to name a rather large number of articles]. What would we do without lumber? The forests are very important, then, aren't they?

Well, you are now going to learn something about how these forests are made into lumber and you must pay close attention to all that is shown you and all that is said.

2. IRON AND STEEL

Instructor addressing class [Cleveland; typical also of Chicago with few alterations to meet local names and situation]:

How many of you have ever been on the High Level Bridge? How many have seen the big piles of red dirt around the lake? Where did it come from? [From the mines] [From Minnesota] On what lake is it? [Lake Superior] What is the most important city from which it is shipped? [Duluth] Do they find it in any other state? You must watch the map given in the picture. What do they do with these piles of ore? [They make it into iron] [They make it into pig iron] Is pig iron, iron? What is it? They are going to make steel from the iron. Are they getting the iron out of the iron ore? Just melt it and then it is iron. What are they going to put in the furnace? [Limestone] You want to find out what they put into it. If the iron ore is not iron what is it? Suppose you have iron ore, is that iron? Iron ore is dirt. How are they going to get the iron out of that dirt? In what kind of a furnace are we going to do this? [Blast furnace] Do you know what a blast furnace is? Well, keep your eyes open and you will know more about these things I have been asking.

The outline of part of the film follows by subtitles and scenes (subtitles italicized) in the order named. The outline of the film, *Lumbering in the North Woods*, is given in chapter iii, p. 211.

IRON AND STEEL

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Outline of Contents

(Subtitles Italicized)

This is the age of steel. Our comfort and happiness depend upon a multitude of steel tools and machines. Steel makes modern progress. Steel is the blood and life of a nation. Steel is obtained from iron ore which is widely distributed in the earth's crust. The largest ore deposits of the world are in the United States.

Animated map shows principal iron ore mines and ports of the United States.

Lake Superior iron ore mines.

Two scenes: one showing men coming from a mine, the other showing the small ore cars unloading into bins.

Ore goes to great steel centers in 600-foot steel boats, loads of 10,000 tons are placed in boats in 60 minutes at Lake Superior docks.

Picture of ore boat.

It is 1,000 miles to Lake Erie. Ore is carried this distance for \$1.00 per ton. This is the cheapest freight rate in the world.

Another picture of an ore boat.

The great ore cargo is unloaded by gigantic machinery. Millions of tons are piled on the docks or into waiting cars. Ashtabula, Cleveland, Erie, Conneaut, and Buffalo are the greatest ore ports.

Scene showing the unloading of ore from boats by gigantic cranes.

Iron ore is smelted by the intense heat of burning coke in a blast furnace. Limestone removes the impurities in form of slag. Note the high furnace, the tipples, the tuyeres, or air blast pipes.

Two pictures: one showing a blast furnace, the other an animated diagram illustrating the unloading of the ore by cranes, the location of the piles of limestone, coke, and ore, and the general process of smelting in the blast furnace.

Vast piles of ore, coke, and limestone are stored near the furnace.

Scene as indicated in the subtitle.

Charging the furnace. Follow the bucket as it empties its ore into the furnace.

A close-up view of a traveling bucket emptying ore into the top of a blast furnace.

4. THE TESTS

A battery of four tests were given each group. One test was verbal and the remaining three were picture imagery tests. The verbal selection and diagram tests were administered to

each group immediately before and after each instruction period. Two other tests called the imagery identification and sorting tests were also given after the period of instruction. Since the four tests were the same type for both the lumber and iron and steel experiments, the tests for both units will be described together.

The following instructions were given to each group at the beginning of the test period.

"Everyone place the paper you have back side up so that no printing appears. . . . Do you remember the little tests in a little booklet you took the other day where you answered questions by underlining or marking out a word? [Here the examiner referred to the intelligence tests given a few days previous to the experiment.] Well, this test must be answered in the same way. All you have to do is to draw a line under the word or group of words in the parentheses which give the best answer. For example, let us suppose that we had the sentence: Ohio is in (Spain, England, France, Germany, the United States). [This question was written on the board by the examiner.] Which word would you underline? . . . Yes, United States. Take this sentence: Cleveland is in (Illinois, West Virginia, Missouri, Iowa, Ohio). [This was written on the board again.] Which one would you underline? Yes, Ohio. Well this is the way you are supposed to answer the questions in this test: *Underline the word or group of words which give the best answer.*

"At the top of the page is a place for your name, grade, and date. After the word 'pupil' write your name; after the word 'grade' write your grade (VB, VA, VIB, VIA) and your room number; after the word 'date' write the date of today. Now turn over your papers and put down these things (name, grade, and date) and when you have finished turn your papers back side up again and raise your hands so that I may know that you are ready for the test."

When the group was ready the examiner gave the signal to commence answering questions. By using a stop watch the examiner allowed exactly three minutes for the first sheet and stopped any of the pupils who had not finished in that time. The pupils were instructed to turn their pages blank side up and place them at one side of their desks. The second and third sheets (second sheet only in case of the lumber experiment since there were only two sheets in the test) were then passed out to the pupils.

"On these two sheets of paper are some more questions like those you have just been answering. Go right ahead with them in the same way. At the bottom of the second sheet you will see Question 27 (22 in case of lumber tests) which says that you are to draw a diagram and label the

things you put in it. On the third sheet near the top of the page is a list of things you are supposed to put in your diagram.

"Do you know what a diagram is? Well, it is a little picture to represent some object. . . . It doesn't have to be a very pretty picture, but just a rough sketch. For example let us suppose that you want to draw a little diagram of the moon. A small circle would be all right for that. Or let us imagine that you wanted to draw a diagram of a box; a square would do very well. But you must label your little pictures or diagram. Do you know what it means to label? Well, it means to write down what the object is. Have you seen a label on a medicine bottle? It tells what kind of medicine it is, doesn't it? Well, you must write a word or two beside your little pictures so that someone else will know what your little picture stands for. You might draw a circle and want to show the moon, but we wouldn't know whether you meant the moon or an apple or an orange or a baseball, so you want to be sure to write a word beside your picture so that we will know what it means. Begin first at the top of the page and answer the questions as you come to them. Draw your diagram either on the back of the second page or at the bottom of the third page. Every one ready? Go."

At the end of six (6) minutes the examiner stops the pupils whether they have finished or not. The papers are then collected.

The verbal-selection test was scored on the basis of the number of points in the questions correctly answered. Although the number of possible points in a question varied, as a rule there was only one point. The verbal-selection and diagram test blanks and the point value of each question for both the lumber and steel experiments, are submitted.

TEST ON LUMBERING

(The point value of each question follows the question in parentheses)

Pupil———

Grade———

Date———

[Underline the word in the parentheses making the correct sentence or answer]

1. Which country uses the most wood per capita and has the richest useful forests? (Great Britain, Canada, India, Brazil, United States, Germany, Russia.) (1)
2. The greatest forests of the United States are found in five of the following states (Louisiana, Wisconsin, Washington, Michigan, Oregon, Kansas, Rhode Island, Nebraska, North Dakota, South Dakota). (1)
3. The lumbermen live in (bungalows, tents, log huts, frame houses, railroad box-cars). (1)

4. The lumber camp is located (on a prairie, in a field, near a city, on the side of a hill, in the forest). (1)
5. Lumbering is done in the north woods in (summer, autumn, spring, winter, May). (1)
6. The fall of the tree is directed by (the wind, pulling a rope fastened to the tree, pushing the tree, sawing, notching the side of the tree). (1)
7. The first thing done after the tree falls is to (remove the brush and large branches, haul it to a railroad, take out the stump, split the tree). (1)
8. The tree is quickly cut into logs by use of a (wedge, an ax, special motor saw, hatchet). (1)
9. The ice road is prepared by (use of a road scraper, making a road bed out of a brush, sprinkling from a water tank, melting the snow). (1)
10. Large loads of logs are easily moved by (men, Fords, wagons, tractors). (1)
11. Logs are taken to the railroad (on trucks, on ice skids, on lumber wagons, carried by men). (1)
12. Sometimes the logs are transported to the mills by (aeroplanes, streams, carts, Ford trucks). (1)
13. Log jams are prevented and the logs are kept moving by (blocks of ice, heavy rains, strong current, lumber jacks, shallow water). (1)
14. A log jam is sometimes opened by (dry weather, falling trees, men in canoes, dynamite). (1)
15. A log jam must be quickly broken or the (logs will stand on end, logs will break, logs will cause the stream to overflow, logs will be left as stream subsides). (1)
16. The owner of a log is shown by (a shipping tag, a rope around one end, a nail in the center, a mark cut at the end). (1)
17. As the logs float into the storage pond they are (marked, painted, cut, sorted). (1)
18. The logs are pulled up to the saw by (men, horses, moving chain with hooks, trucks). (1)
19. Green lumber is usually dried and seasoned in (a wooden hut, a steam-heated kiln, in a pond, by hot air). (1)
20. Newly sawed lumber may be seasoned in the open if (it is piled on end, the air circulates freely about it, it is piled close together). (1)
21. Our supply of lumber is (very great, will soon be exhausted, will last forever, is barely touched, is increasing). (1)
22. By making a diagram on the back of the first sheet, trace the route taken by a log until it is sawed into boards. (10)
Include and label in your diagram the following things:
 - a) Where and how it is finally piled.
 - b) Location of mill.

- c) How logs are prevented from jamming.
- d) Where the tree is located.
- e) How logs are made into lumber.
- f) How the fallen tree is made into logs.
- g) Where lumber is seasoned.
- h) Where logs are kept after arrival at mill until needed.
- i) How logs are transported by water.
- j) How logs are taken to the train.

Total possible points verbal test 21

Total possible points diagram test 10

QUESTIONS ON IRON AND STEEL

(The point value of each question follows the question in parentheses)

[Underline the word in parentheses making the correct sentence
or answer]

1. Steel is obtained from (coal, rock, iron ore, clay, sand) which is widely distributed in the earth's crust. The largest deposits of the world are in the (British Isles, United States, West Indies, Philippines). (2)
2. The ore deposits are located in the northern part of (Minnesota, Alabama, Florida) (Michigan, Missouri, Illinois), (Wisconsin, Utah, Texas), and south of Lakes (Erie, Michigan, Huron, Ontario, Superior). (4)
3. How far is it from the ore deposits to the Lake Erie ports (1,000 yards, 1,000 miles, 20 feet, 5,000 miles)? (1)
4. Ore is carried this distance in (automobiles, sleds, boats, wagons). (1)
5. In this space draw a picture of one of these (1)
6. The great ore cargo is unloaded by (coolies, mules, men, machinery). (1)
7. In what two places is the ore put when it is unloaded?
(1) (on docks, on elephants, on mules).
(2) (into railroad cars, into automobiles, into sleds). (2)
8. Name four great ore ports. (1) (Detroit, Chicago, St. Louis, Cleveland). (2) (Toledo, Toronto, Kansas City, Erie). (3) (Ashtabula, New York, Utica, Albany). (4) (Philadelphia, Buffalo, Dayton, Meadville). (4)
9. The intense heat of a blast furnace is produced by burning (ashes, coke, wood, air). (1)
10. Slag is made by (limestone, rock, granite, crystal) plus (mud, impurities, apples). (2)
11. Vast piles of (oranges, limestone, clay), (mud, coke, wood), and (coal, iron ore, slag) are stored near the blast furnace. (3)

12. In charging the furnace (dirt, wood, iron ore, brick) is poured into the furnace by a bucket at the top, then (lumber, coal, coke, ashes) is poured in through another bucket and finally (salt, limestone, pebbles, clay) is added to the mixture. (3)
13. The slag comes from (top of liquid iron, middle of liquid iron, bottom of liquid iron, side of liquid iron). (1)
14. The slag goes (into a pit, up in smoke, in the fire box, in the lake). (1)
15. Where does the fiery stream of liquid iron come from (top of furnace, bottom of furnace, side of furnace)?
Where does the fiery stream of liquid iron go (into large ladles, into small cans, on the ground)? (2)
16. What does a pig-iron mold look like? Draw a picture to illustrate it. (1)
17. How is steel made (by remelting pig iron in an open-hearth furnace, by throwing pig iron on the ground, by exposing pig iron to the sun)? (1)
18. How much melted steel will a ladle hold (20 tons, 80 tons, 2,000 lbs., 200 tons)? (1)
19. Steel is first cast into huge (cars, ingots, wagons). (1)
20. Then a (train, automobile, ship) takes the huge (cars, ingots, wagons) to heating pits to prepare for the (blast, rolling mill, flour mill). (3)
21. In the bloom mill steel is worked into a rod by (great hammers, heavy rollers, compressed air, sharp saws). (1)
22. How are thin rods made (by heavy rollers, by great hammers, by men with hammers)? (1)
23. What do the thin rods look like (snakes of fire, garden hose, coils of rope)? (1)
24. Name four steel centers of the United States (1) (Albany, Buffalo, New York), (2) (Akron, Cleveland, Detroit), (3) (Kansas City, Gary, St. Louis), (4) (Meadville, Pittsburgh, Reading). (4)
25. They are located near the (Great Lakes, Mississippi River, farm lands), and (coal, wood, gold, and silver). (2)
26. Why does most of the ore go to Lake Erie ports?
Because they are near the (best farm lands, the best road ways, the best coal fields, the Allegheny Mountains, most thickly populated sections). (1)
27. Draw a diagram on the back of this sheet showing the route taken by iron ore from the Montana mines until it becomes a steel rod. Label each part of your diagram so we will be sure you know each step in making iron ore into steel. (10)

The diagram should include the following things:

How the steel bars are finally shaped and prepared.

The location of the mines where the ore is found.

The way in which the ore is unloaded.

What goes into and comes out of the blast furnace.

The route from the mines to ports of destination.

Where the ore is first placed.

Where the limestone and coke are placed.

The location of the ports where the ore is unloaded.

What goes in and comes out of an open-hearth furnace.

What happens to the ingots.

Total possible points verbal test 46

Total possible points diagram test 10

The diagram tests were scored in the following manner. One point was given for each item in the furnished list, correctly designated and correctly arranged. For instance, if, in the lumber experiment, a child drew a rough sketch of the location of the trees in definite relation to any other of the items called for two points were given: one for each item. If three items were clearly designated and properly arranged, three points were given. The list of items given on the prepared blanks was purposely disarranged so that each child would have to produce not only a correct representation but also a proper sequence and arrangement of the ideas. No credit was given if the items were placed in an order different from that shown in the instruction period.

The imagery-identification tests consisted of a series of twelve lumber and steel pictures which the pupils were supposed to identify. The pupils were supplied with forms containing the key clauses and sentences underneath which the pupil was supposed to write the number of the appropriate picture of the series: one point was given for each proper identification. The total score, then, was equal to the number of pictures in the tests. These pictures were not exact duplicates of the different scenes shown by the films, but were photographs very closely parallel to the main processes portrayed in the film and slide instruction.

The imagery-identification test was administered immediately following the verbal and diagram tests. When the examiner had given test blanks to each pupil he offered the following directions:

Everyone look at the first sentence at the top of the page. Read together: "Place the number of the picture underneath the words that tell what the picture shows." Look at the first group of words. Read: "Place where the ore comes from." Let us imagine that number 13 showed where the ore comes from; then you would put this number underneath these words. There are thirteen pictures in all; one picture for each group of words. There are about thirty pupils in this group so there should not be more than three pupils around any one picture at the same time. When you see a large number of pupils around one picture go to another one. Study them all until you have placed a number beneath each group of words. Be very careful not to copy from anyone's sheet. In order to keep from doing so carry your paper folded against you so that no one can look over your shoulder.

When you study a picture keep your paper folded and when you want to write down the number of the picture go away to one side by yourself to write it. Take your time and don't be afraid to erase or change a number for you may not be right at first. And don't be anxious when someone else finishes early, for the early ones are not always most right. . . . Every one begin.

The blanks for the imagery test in both the lumber and steel experiments are herewith submitted.

IMAGERY-IDENTIFICATION TEST BLANK FOR LUMBER EXPERIMENT

[Place the number of the picture underneath the words that tell
what the picture shows]

Where the lumbermen live.

The first step in turning a tree into a log.

The second stage in making a log from a tree.

The first preparation for taking logs from the forest.

Logs first beginning to move from forest.

Ready to start for mill.

Logs waiting for swollen streams.

Logs waiting for lumber jacks or dynamite.

Where logs are kept at end of journey.

Log moving for last time before being sawed.

Where the log is changed into its last form.

The finished product.

IMAGERY-IDENTIFICATION TEST BLANK FOR THE STEEL EXPERIMENT

[Place the number of the picture underneath the words that tell what the picture shows]

Place where the ore comes from.

Transportation of ore.

Unloading of ore.

Furnace for separating iron from ore.

Slag and molten iron leaving furnace.

Running iron into mold.

Drawing off steel.

Pouring steel into molds.

Removing molds from steel ingots.

Reheating ingot.

Rolling ingot.

Making rods.

Finished product.

Following the imagery test each group was given the sorting test. For this test, each pupil was provided with a set of mounted photographs printed from selected portions of the steel and lumber films used in the instruction. The pupil received the packet of pictures in a mixed order. The task of the test was to arrange them in proper sequence, i.e., in the order as shown by the instruction. Numbers were written on each picture. Each pupil, after he had sorted the pictures, recorded his arrangement of the pictures by writing the numbers in a column in the same order as they appeared on the separate prints.

The examiner gave the following directions to each group:

I am going to give you a set of small pictures just like those you saw in the (film, slide, or like those you saw on your desk, in the case of the print instructed groups). Now I want you to go to one part of the room by yourself, and spread out the pictures on the floor, or on top of two desks, or on the window sill—any place that is convenient. Then I want you to place them in the same order that you saw in the pictures. Fix them so that they will tell a story from the beginning to the end. Let us suppose we had a set of pictures showing how you leave home to come to school every day. The first picture would show you leaving your house; the next one would show you going out of your front yard; then the next to last one would show you going into the school yard, and the last one would show you going into the school building. Now you want to arrange these pictures in the same way—so they will tell a story about what you have been seeing.

Directions for the sorting test continued:

When you have arranged the pictures in the right order, then take your last sheet of paper [referring to the imagery test blanks] and write down the numbers in the column in the same order that they appear on your pictures. [Here the examiner illustrated by making a column of figures on the board.] Take all the time you want to, for I want you to arrange the pictures correctly.

The scoring of the sorting test was done as follows: For every picture in its exact position in the series, one point is given. For example, if a picture is thirteenth in position when the entire series is properly arranged, and is also thirteenth in the series as arranged by the child, one point is given. The same is true of all the other pictures. If a picture is one position on either side of its position in the proper arrangement, one-half point is given. For example, if a picture's proper rank is 15, and a child places it sixteenth or fourteenth in order, one-half point is given.

The proper position of each picture is based on the sequence of the picture as it appears in the film. The scoring scheme is contrived so as to measure the closeness with which the child approaches the sequence as portrayed in the film, slide, or print instruction, in each case the arrangement or sequence remaining the same.

[NOTE.—Eighteen pictures were used in the lumber sorting tests both in Cleveland and in Chicago; thirty-six pictures were used in the steel sorting tests in Cleveland and only eighteen in Chicago.]

Since the prints of both the lumber and steel films were not available in the early stages on the experiments, the sorting tests were not administered to the groups of the North Doan School in Cleveland. For the remaining experiments in Cleveland and all of those in Chicago the sorting tests for both the lumber and steel units were given.

All of the test papers were tied in bundles, labeled, and shipped to Urbana, Illinois, where a group of five students carefully trained by the writers, scored, rescored, and tabulated the results. These students were in charge of Miss Margaret Mueller who had had experience with scoring the papers in the

Urbana experiments and who had assisted the writers in working out the scoring schemes for the foregoing battery of four tests.

RESULTS

The reader should be advised at this point in the description of the lumber and iron and steel experiments, first, that these experiments represent an ambitious attempt to control all the variable factors in a complex situation with the best experimental technique known at the present time, and second, that the measurement of the product of instruction was in terms of the types of the imagery taught. It took from 90 to 120 minutes to run each group through the preliminary test period, the instruction period, and the final test period. The attempt to control all factors created a complex situation which in itself, perhaps, defeated its own purpose. However, when the reader considers that the experiments were repeated in three different schools, the variable factors tend to offset each other and a definite difference in the averages may be taken to indicate a real difference in effectiveness.

The tables are all built on the same plan. The nature of the instruction to each group is indicated in the first column. The number of pupils in each group is shown in the second column, and so on across the tables. One will find the explanation of the data in each column. (Let us digress here to say that the original groups were larger, but in pairing the pupils by intelligence scores and verbal test scores the size of the groups was reduced to the figures shown.)

An inspection of Table I shows that the film-talk, film-no-talk, print-talk, and print-no-talk groups rank from highest to lowest in the total score in the order named.

Since the lumber experiment was repeated in its entirety at the Mount Auburn School let us turn to Table II. Two more groups, slide-talk and slide-no-talk, were included in the Mount Auburn experiment and the sorting test was added.

Table II shows that the film-talk and print-talk groups rank first, the print-no-talk group second, the slide-talk group third, the film-no-talk group fourth, and the slide-no-talk group last in the total score.

TABLE I
THE RESULTS OF THE EXPERIMENT WITH THE FILM "LUMBERING IN THE NORTH WOODS" SHOWING
THE AVERAGE SCORES MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE
TAKEN FROM THE FIFTH GRADE, NORTH DOAN SCHOOL, CLEVELAND, OHIO

GROUP	No. PUPILS PER GROUP	INTEL- LIG- ENCE TEST SCORE	CHRON- OLOGICAL AGE IN Mos.	MEN- TAL AGE IN Mos.	INTEL- LIG- ENCE QUO- TIENT	PRELIMINARY TEST				FINAL TEST							
						Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Identi- fica- tion Test	Mean Devia- tion	Total Score	Mean Devia- tion
Film-talk...	13	53.46	130.77	130.53	98.92	7.76	1.04	.64	.96	17.46	2.74	1.93	1.18	5.54	2.73	24.93	6.13
Film-no-talk	13	53.46	130.76	130.23	99.23	7.76	1.08	.92	1.00	16.89	1.68	1.46	1.12	6.23	2.15	24.53	6.01
Print-talk...	13	53.46	129.38	130.77	101.53	7.76	1.94	1.76	.93	15.76	2.56	2.23	1.10	4.53	1.35	22.54	5.71
Print-no- talk.....	13	53.53	134.07	132.23	97.77	7.69	1.72	2.76	1.33	14.07	3.76	3.38	2.10	5.38	1.91	22.84	6.47

TABLE II
THE RESULTS OF THE EXPERIMENT WITH THE FILM "LUMBERING IN THE NORTH WOODS" SHOWING THE
AVERAGE SCORES MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE TAKEN FROM
THE FIFTH AND SIXTH GRADES (COMBINED), MOUNT AUBURN SCHOOL, CLEVELAND, OHIO

GROUP	No. PUPILS PER GROUP	INTEL- LI- GENCE TEST SCORE	CHRON- OLOGIC- CAL AGE IN Mos.	MEN- TAL AGE IN Mos.	INTEL- LI- GENCE QUO- TIENT	PRELIMINARY TEST				FINAL TEST									
						Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Iden- tifica- tion Test	Mean Devia- tion	Sort- ing Test	Mean Devia- tion	Total Score	Mean Devia- tion
Film-talk . . .	15	54.86	147.53	131.74	91.66	7.00	2.60	.26	.42	17.06	2.54	1.80	1.69	4.66	2.09	8.33	2.41	31.86	5.51
Film-no-talk. . .	15	54.86	140.00	131.32	94.06	7.00	2.15	.40	.69	13.33	2.71	.86	1.02	5.40	1.82	7.86	4.39	27.46	6.30
Slide-talk . . .	15	54.80	145.20	131.80	91.86	7.00	2.40	.26	.46	15.13	3.19	1.66	1.74	3.60	2.16	7.46	3.62	27.86	6.18
Slide-no-talk. . .	15	54.80	146.20	132.04	91.60	7.06	2.21	.86	1.01	12.93	2.08	1.46	1.42	4.40	1.76	5.60	3.68	24.40	6.90
Print-talk . . .	15	54.86	143.93	132.45	93.20	7.00	2.26	1.66	1.35	15.86	2.00	3.06	2.07	5.06	2.43	7.40	3.10	31.86	6.41
Print-no-talk. .	15	54.86	140.20	131.90	94.26	7.00	2.26	2.00	1.93	12.86	3.76	2.93	.61	4.66	1.04	8.06	3.47	28.24	5.37

The only consistent result obtained from the two experiments is the fact that the "talk groups" rank higher than the "no-talk groups" for each form of presentation, film, slide, and print, in each experiment. This shows that the addition of oral discussion distinctly increases the effectiveness of the presentation whether it be by film, slide, or print.

At Chicago the lumber experiment was repeated twice, (1) in Grades IV A and V B and (2) in Grade VI B of the Thomas Herzl School. Four methods of instruction were used, film-no-talk, slide-no-talk, print-talk and print-no-talk. The results are shown in Tables III and IV.

An inspection of the total scores in Tables III and IV shows the relative position of the groups is the same in both cases with the exception that the film-no-talk group ranks first in Table III and second in Table IV, changing places with the print-talk group. Both of the film-no-talk groups and the print-talk groups rank higher than the print-no-talk groups, which in turn are higher than the slide-no-talk groups. These results show (1) that print-talk instruction was more effective than print-no-talk, (2) that both film and print instruction were superior to slide-no-talk instruction, and (3) that there is little choice between print-talk and film-no-talk instruction.

RESULTS FROM "IRON AND STEEL"

The second group of experiments, built around the film, *Iron and Steel*, were conducted with a technique identical with that used in the lumbering experiments. In view of this fact the issues for both cycles of experiments are the same, and the broad conclusions to be drawn from both groups of experiments will be deferred until the data and results of the experiments on "Iron and Steel" are presented.

The following tables, V-VIII inclusive, contain the results of the experiments employing the film *Iron and Steel*. Tables V and VI present the data from the experiments conducted in Cleveland, Tables VII and VIII show the data from the experiments conducted in Chicago.

TABLE III
THE RESULTS OF THE EXPERIMENT WITH THE FILM, "LUMBERING IN THE NORTH WOODS," SHOWING THE
AVERAGE SCORE MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE
TAKEN FROM THE FOURTH AND FIFTH GRADES, THOMAS HERZL SCHOOL, CHICAGO

GROUP	No. PUPILS PER GROUP	INTEL- LIG- ENCE TEST SCORE	CHRON- OLOGIC- AL AGE IN Mos.	PRELIMINARY TEST				FINAL TEST									
				Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Identifi- cation Test	Mean Devia- tion	Sort- ing Test	Mean Devia- tion	Total Score	Mean Devia- tion
Film-no- talk.....	15	59.66	129.06	6.66	1.20	.26	.45	13.13	3.31	.33	.57	4.46	1.09	7.73	3.82	25.66	6.37
Slide-no- talk.....	15	59.93	130.46	6.73	2.05	.26	.45	11.00	3.73	1.86	1.24	3.80	1.70	3.40	2.40	20.06	6.18
Print-talk..	15	59.80	123.20	6.66	1.60	.66	.95	15.40	2.30	1.80	1.44	2.80	1.05	3.13	1.87	23.26	5.91
Print-no- talk.....	15	59.73	128.26	6.66	1.30	.86	1.15	11.66	2.75	1.80	1.20	4.53	1.69	4.40	2.82	22.40	6.25

TABLE IV
THE RESULTS OF THE EXPERIMENT WITH THE FILM "LUMBERING IN THE NORTH WOODS," SHOWING THE
AVERAGE SCORES MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE
TAKEN FROM GRADE VI B, THOMAS HERZL SCHOOL, CHICAGO

GROUP	No. PUPILS PER GROUP	INTEL- LI- GENCE TEST SCORE	CHRON- OLOGICAL AGE IN Mos.	PRELIMINARY TEST				FINAL TEST							
				Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Identi- fica- tion Test	Mean Devia- tion	Sort- ing Test	Mean Devia- tion
Film-no-talk	25	82.20	141.68	10.96	2.24	1.56	1.37	17.20	2.27	2.76	1.03	8.72	3.36	35.20	8.13
Slide-no-talk.....	25	82.12	141.34	10.84	3.28	2.24	1.36	17.76	2.71	3.40	1.42	3.20	3.64	31.00	6.97
Print-talk...	25	82.36	139.28	10.96	1.73	2.08	1.44	19.92	1.78	2.44	1.78	8.80	3.94	37.76	8.01
Print-no-talk.....	25	82.20	145.24	10.92	2.45	2.34	.73	17.60	3.12	3.48	1.15	5.92	4.49	33.08	7.08

TABLE V
THE RESULTS OF THE EXPERIMENT WITH THE FILM "IRON AND STEEL," SHOWING THE AVERAGE SCORES
MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE TAKEN FROM
THE FIFTH GRADE, NORTH DOAN SCHOOL, CLEVELAND, OHIO

GROUP	No. PUPILS PER GROUP	PRELIMINARY TEST				FINAL TEST											
		INTEL- LI- GENCE TEST SCORE	CHRON- OLOG- ICAL AGE IN Mos.	MEN- TAL AGE IN Mos.	INTEL- LI- GENCE QUO- TIENT	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Identi- fica- tion Test	Mean Devia- tion	Total Score	Mean Devia- tion
Ffilm-talk...	13	60.07	132.16	135.51	104.92	12.85	3.53	0	0	27.92	3.34	.15	.28	2.30	1.24	30.38	5.87
Ffilm-no-talk	13	61.69	140.18	136.76	98.46	13.00	2.77	0	0	25.23	4.49	.38	.54	3.39	2.03	28.92	5.97
Slide-talk	13	61.30	133.61	136.61	102.54	12.92	4.29	0	0	26.69	4.77	1.07	1.48	4.54	1.46	32.30	5.75
Slide-no-talk	13	61.69	133.69	140.03	107.00	13.00	2.77	.15	.28	23.84	4.45	1.00	1.23	2.53	1.81	27.38	5.82
Print-talk...	13	59.84	133.23	139.84	103.69	13.00	3.69	.15	.28	22.00	4.15	.77	1.18	3.00	1.69	25.77	6.14
Print-no- talk.....	13	60.84	131.84	140.23	107.00	13.00	3.92	.15	.15	24.39	4.37	.23	.42	3.77	1.29	28.39	5.68

TABLE VI

THE RESULTS OF THE EXPERIMENT WITH THE FILM "IRON AND STEEL," SHOWING THE AVERAGE SCORES MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE TAKEN FROM THE FIFTH AND SIXTH GRADES COMBINED, MOUNT AUBURN SCHOOL, CLEVELAND, OHIO

GROUP	No. PUPILS PER GROUP	PRELIMINARY TEST					FINAL TEST												
		INTEL- LIGENCE TEST SCORE	CHRONOLOGICAL AGE IN Mos.	MENTAL AGE IN Mos.	INTEL LIGENCE QUOTIENT	Verbal Test	Mean Deviation	Dia-gram Test	Mean Deviation	Verbal Test	Mean Deviation	Dia-gram Test	Mean Deviation	Iden-tifica-tion Test	Mean Devia-tion	Sort-ing Test	Mean Devia-tion	Total Score	Mean Devia-tion
Film-talk...	14	59.07	148.00	137.00	94.14	13.14	1.55	0	0	26.28	4.61	1.28	1.83	5.21	1.42	9.64	7.73	42.42	8.25
Film-no-talk...	14	59.00	141.92	136.50	97.92	13.21	2.47	.14	.26	18.85	4.92	.50	1.86	2.78	1.53	3.57	2.17	25.71	6.19
Slide-talk...	14	59.05	144.42	136.94	95.64	13.14	1.37	.14	.26	26.85	2.14	1.00	1.14	4.42	2.37	8.78	1.96	41.05	0.31
Slide-no-talk...	14	59.07	143.00	136.88	96.50	13.21	4.36	.28	.48	24.07	5.94	.50	.78	3.00	1.14	4.92	2.03	32.53	0.18
Print-talk...	14	59.05	149.92	137.08	98.14	13.14	2.79	.14	.26	26.07	4.92	.82	1.45	3.92	1.71	8.85	1.73	39.78	6.01
Print-no-talk..	14	59.07	145.78	137.40	95.35	13.07	2.57	.14	.26	19.42	4.21	.85	1.22	4.35	1.55	5.85	2.69	30.50	6.53

TABLE VII
THE RESULTS OF THE EXPERIMENT WITH THE FILM "IRON AND STEEL," SHOWING THE AVERAGE SCORES
MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE TAKEN FROM
GRADES IV A AND V B, THOMAS HERZL SCHOOL, CHICAGO

GROUP	No. PUPILS PER GROUP	INTEL- LI- GENCE TEST SCORE	CHRON- OLOGICAL AGE IN Mos.	PRELIMINARY TEST				FINAL TEST									
				Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Identi- fica- tion Test	Mean Devia- tion	Sort- ing Test	Mean Devia- tion	Total Score	Mean Devia- tion
Film-no-talk	26	62.03	134.38	9.30	2.07	0	0	18.00	4.08	.42	.71	3.03	1.62	.73	.52	22.19	5.15
Slide-no-talk.....	26	62.11	125.72	9.30	2.49	0	0	15.61	6.26	.03	.07	1.30	1.35	1.30	.73	18.26	7.00
Print-talk....	26	61.96	128.71	9.30	2.16	.15	.28	16.96	3.73	.15	.28	2.65	1.45	1.15	.35	20.92	6.78
Print-no-talk.....	26	62.11	128.61	9.30	2.63	0	0	15.73	5.32	.26	.48	3.30	1.84	1.07	.43	20.38	7.08

TABLE VIII
THE RESULTS OF THE EXPERIMENT WITH THE FILM "IRON AND STEEL," SHOWING THE AVERAGE SCORES
MADE BY THE GROUPS IN THE SEVERAL TESTS. THE GROUPS WERE TAKEN FROM
GRADE VI B, THOMAS HERZL SCHOOL, CHICAGO

GROUP	No. PUPILS PER GROUP	INTEL- LIGENCE TEST SCORE	CHRON- OLOGICAL AGE IN Mos.	PRELIMINARY TEST				FINAL TEST									
				Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Verbal Test	Mean Devia- tion	Dia- gram Test	Mean Devia- tion	Identi- fica- tion Test	Mean Devia- tion	Sorting Test	Mean Devia- tion	Total Score	Mean Devia- tion
Film-no-talk	24	82.50	139.95	14.79	3.97	.08	.15	24.45	3.55	.71	.91	2.08	3.10	1.62	.65	28.87	6.18
Slide-no-talk	24	82.66	139.87	14.79	3.52	.00	3.00	26.04	3.96	.87	1.16	4.75	2.33	1.33	.51	33.00	5.75
Print-talk...	24	83.00	141.99	14.79	3.64	.00	.00	22.78	4.69	.45	.72	4.95	1.76	1.16	.34	29.37	6.81
Print-no- talk.....	24	82.75	142.18	14.75	3.95	.08	.15	21.26	3.85	.50	.75	5.39	1.89	1.35	.59	28.50	6.73

Before discussing the results in the preceding tables it should be again mentioned that the sorting test was not used in the North Doan experiments in Cleveland, so results from that test do not appear in Table V.

An inspection of the results shown in Tables V and VI shows that the total score is the best guide on which to compare the effectiveness of the various forms of presentation. At North Doan the groups rank from highest to lowest as follows: (1) slide-talk, (2) film-talk, (3) film-no-talk, (4) print-no-talk, (5) slide-no-talk, and (6) print-talk. At Mount Auburn the rank order of the groups does not parallel those given in Table V. We find the film-talk groups ranks first, the slide-talk second, the print-talk third, the print-no-talk fourth, print-talk fifth, and film-no-talk sixth. Tables V and VI agree in one respect, namely, that in all but one case the groups receiving oral instruction excel those receiving the corresponding type of instruction minus the oral accompaniment.

Let us now turn to the results of the *Iron and Steel* experiments as conducted in Chicago. These results are contained in Tables VII and VIII.

An inspection of the total scores in Tables VII and VIII shows again that the results do not parallel each other in the two cases except for the fact that the print-talk groups excel the print-no-talk groups.

The inconsistency of the results from these experiments with lumbering and iron and steel, with the exception of the talk versus no-talk comparisons, leads the writers to resort to combinations of scores, where the groups were comparable, in order to show the major tendencies in the results.

COMPARISON OF RESULTS

Eight cases are presented in Table IX to show the relative effectiveness of oral comment when it accompanies the film, slide, and illustrated text. In every case the oral discussion adds distinctly to the effectiveness of the presentation. In the two cases where oral discussion was given during the projection of

the film, the film-talk groups made total scores 10.49 per cent (lumber) and 24.44 per cent (iron and steel) higher than the

TABLE IX

THE RELATIVE EFFECTIVENESS OF ORAL COMMENT WHEN IT ACCOMPANIES THE FILM, SLIDE, AND ILLUSTRATED TEXT IS SHOWN BY THE AVERAGE SCORES MADE BY THE GROUPS IN THE VARIOUS TESTS. THESE AVERAGES ARE TO BE COMPARED ONLY FOR SHOWING THE RESULT OF TALK VERSUS NO-TALK FOR A GIVEN TYPE OF VISUAL AID. FOR EXAMPLE, CLEVELAND PRINT-TALK SCORES IN THE LUMBER EXPERIMENT CANNOT BE COMPARED, IN THIS TABLE, WITH CLEVELAND FILM-TALK SCORES IN THE LUMBER EXPERIMENT

FORM OF PRESENTATION	NO. OF PUPILS	PRELIMINARY TEST		FINAL TEST				
		Verbal Test	Diagram Test	Verbal Test	Diagram Test	Identification Test	Sorting Test	Total Score.
	Cleveland. North Doan and Mount Auburn Scores Combined							
Lumber:								
Film-talk.	28	7.36	.43	17.25	1.86	5.07	.....	24.18
Film-no-talk.	28	7.36	.64	14.96	1.14	5.79	.....	21.89
Steel:								
Film-talk.	27	13.00	.00	27.07	.74	3.82	.....	31.62
Film-no-talk.	27	13.11	.07	21.92	.45	3.04	.....	25.41
Lumber:								
Slide-talk.	15	7.00	.26	15.13	1.66	3.60	.....	20.40
Slide-no-talk.	15	7.06	.86	12.93	1.46	4.40	.....	18.80
Steel:								
Slide-talk.	27	13.04	.07	26.78	1.03	4.48	.....	32.29
Slide-no-talk.	27	13.11	.22	23.96	.74	2.78	.....	27.48
Lumber:								
Print-talk.	28	7.36	1.71	15.79	2.68	5.11	.....	23.57
Print-no-talk.	28	7.32	2.36	13.39	3.14	5.00	.....	21.53
Steel:								
Print-talk.	27	13.07	.14	24.11	.85	3.48	.....	28.44
Print-no-talk.	27	13.04	.14	21.81	.55	4.07	.....	26.44
	Chicago. Grades IV A and V B Scores Combined with VI B Scores							
Lumber:								
Print-talk.	40	9.35	1.55	18.28	2.83	4.55	6.68	32.33
Print-no-talk.	40	9.33	1.98	15.40	2.85	5.48	5.35	29.08
Steel:								
Print-talk.	50	11.94	.08	19.76	.30	3.76	1.16	24.98
Print-no-talk.	50	11.92	.04	18.40	.38	4.30	1.20	24.28

film-no-talk groups. Other experiments reported elsewhere in this report agree with this result, which is contrary to the prevailing opinion that one should not talk during the presenta-

tion of a film. Certainly we have established the fact that carefully prepared oral discussion adds to the effectiveness of the presentation of films, as well as slides and illustrated text.

Six comparisons between the film, slide, and illustrated text

TABLE X
COMPARISON OF THE FILM, SLIDE, AND ILLUSTRATED TEXT AS SHOWN
BY THE AVERAGE SCORES MADE BY THE GROUPS IN
THE VARIOUS TESTS

COM- PARI- SON	FORM OF PRESENTATION	No. OF PU- PLS	PRELIMINARY TEST		FINAL TEST				
			Verbal Test	Diagram Test	Verbal Test	Diagram Test	Identifi- cation Test	Sorting Test	Total Score
Cleveland: North Doan and Mount Auburn Scores Combined									
1.....	Lumber:								
	Film-talk	28	7.36	.43	17.25	1.86	5.07	.....	24.18
	Print-talk	28	7.36	1.71	15.79	2.68	5.11	.....	23.57
2.....	Steel:								
	Film-talk	27	13.00	.00	27.07	.74	3.82	.....	31.62
	Slide-talk	27	13.04	.07	26.78	1.03	4.48	.....	32.29
	Print-talk	27	13.07	.14	24.11	.85	3.48	.....	28.44
3.....	Lumber:								
	Film-no-talk	28	7.36	.64	14.96	1.14	5.79	.....	21.89
	Print-no-talk	28	7.32	2.36	13.39	3.14	5.00	.....	21.53
4.....	Steel:								
	Film-no-talk	27	13.11	.07	21.92	.45	3.04	.....	25.41
	Slide-no-talk	27	13.11	.22	23.96	.74	2.78	.....	27.48
	Print-no-talk	27	13.04	.14	21.81	.55	4.07	.....	26.44
Chicago: Grades IV A and V B Scores Combined with VI B Scores									
5.....	Lumber:								
	Film-no-talk	40	9.35	1.08	15.68	1.85	5.75	8.35	31.63
	Slide-no-talk	40	9.30	1.50	15.13	2.83	5.58	3.28	26.80
	Print-no-talk	40	9.33	1.98	15.40	2.85	5.48	5.35	29.08
6.....	Steel:								
	Film-no-talk	50	11.94	.04	21.10	.56	2.58	1.16	25.40
	Slide-no-talk	50	11.94	.00	20.62	.44	2.96	1.32	25.34
	Print-no-talk	50	11.92	.04	18.40	.38	4.30	1.20	24.28

are shown in Table X. These comparisons can be made only between the groups as bracketed.

In six cases where the film and "print" or illustrated text are compared, four show only a very slight advantage for the film, one shows a larger advantage for the film, and one case shows an advantage for the print.

In four cases where the film and slide are compared, two show an advantage for the film and two show an advantage for the slide.

In four cases where the slide and print are compared, two show a slight advantage for the slide, one shows a distinct advantage for the slide and one shows a distinct advantage for the print.

These comparisons show such inconsistent results that the film, slide, and print appear to possess no distinct advantage one over the other as far as these particular experiments are concerned. Hence, in view of the difference in the cost of films as compared with slides and prints it would appear that it would be more satisfactory to use the two latter devices for teaching the two topics taught in the foregoing experiments.

CHAPTER V

AN EXPERIMENT TO STUDY THE EFFECTIVENESS OF A MOTION PICTURE FILM WHICH CONSISTS LARGELY OF TABLES, MAPS, AND CHARTS, AS A MEANS OF TEACHING FACTS OR GIVING ABSTRACT INFORMATION

FRANK N. FREEMAN, E. H. REEDER, AND JEAN A. THOMAS

Motion picture films which are designed for use in schools differ very widely from one another. Some contain chiefly pictures of moving objects with comparatively few pictures of still objects and with comparatively few and brief subtitles. Other films contain a large number of pictures of still objects or animated diagrams. Still others contain a large amount of reading matter or of diagrams, maps, or charts.

In the discussion of educational motion pictures it is usually assumed that they are of the first type. The actual films which are available for use in the schools, however, are often of one of the other types. That this is true is indicated by H. Y. McClusky's survey of films. It is therefore important that the educational value of these other types of films should be studied.

In this experiment a rather extreme example of the motion picture films which contain a large amount of subtitle material has been chosen for study. The subject-matter of this film is not for the most part peculiar to motion pictures. It is factual information of a somewhat abstract sort. Furthermore, this subject-matter is presented by means of reading matter, tables, charts, and maps, with very slight animation. There are a very few motion pictures of railroad trains, railroad yards, etc., but they constitute but a small part of the total footage.

The problem of this experiment, therefore, is this: Can factual information, presented in printed matter, charts, maps,

etc., be more effectively taught by the motion picture, which shows the material in a definite time sequence, for predetermined periods of time, to groups of persons alike, than by the lecture or the ordinary method of individual study? The problem may be grasped more clearly by the inspection of the content of the film and of the parallel reading lesson.

THE FILM AND THE MATERIAL OF THE PARALLEL LECTURE AND STUDY LESSON

The character of the film may be gathered from the following list of titles and brief descriptive statements. The subtitles are in italics. The tables which are included in the following outline appear in the film. The descriptive comments which do not appear in the film are put in parenthesis.

RAILROADS IN THE UNITED STATES

1. *There were no railroads in 1821.*

(Map with title, "U.S. in 1820." Pointer traces boundary of the United States.)

2. *In the early days of America transportation was primitive.*

(Scene supposed to be old-fashioned train. Train goes across tresselled bridge.)

3. *In America, as in England, the earliest railroads were built to hold coal and ore.*

(Map headed, "Railroad Centers, 1820-1840." Shows United States east of Mississippi. Following cities: Boston, New York, Philadelphia, Wheeling, Baltimore.)

(Pointer indicates titles and then different cities. Close-up of eastern portion of United States with coal fields in light color, shown in Pennsylvania, Virginia, West Virginia, and extending down through Mississippi. Also in Illinois and extending south to Louisiana, west of Mississippi.)

(Map showing eastern portion of United States indicating iron fields in a belt extending parallel to and on the east of coal belt from southern New York to Alabama. Another small district east of Mississippi.)

(NOTE.—Iron and coal field shown together in this picture. No indication which is which except variation in shading.)

(Map showing coal and iron fields as before. Title appears in center of picture: "Mining Railroad, 1828-30." No railroads shown.

Names of following towns appear: Honesdale, Quincy, Chester, Carbon-dale, Mauch Chunk.)

(Pointer indicates various cities.)

4. *Following pioneer movements the railroads made rapid settlement possible.*

(Map showing eastern portion of the United States.)

(Title to right of map: "B & O, 1830." Names of cities, Wheeling and Baltimore, printed on map.)

(Pointer points to B & O title and then follows course of railroad from Baltimore to Wheeling, continues under the name Wheeling.)

(Map of eastern portion of the United States showing network of railroads. Title to right of picture: "Railroads 1850, 9,021 miles." Eastern and western railroads shown near Ogden, Utah, 1869.)

(Map of entire United States headed "Railroads." The following cities located: San Francisco, Omaha; network of railroads east of Mississippi with date 1860 in center. Word *Eastern* appears above Great Lakes.)

(Words *Western*, *Central*, and *Union Pacific* appear over western portion of United States.)

(Animated line starts from Omaha and another from San Francisco, meet at Ogden, Utah, and date 1869 appears above words *Union Pacific*.)

(Words *Gulf of Mexico* and *Canada* appear. Date 1883 appears in center of map.)

5. *Although cost of construction was increasing, railroad building continued. Growth of railway mileage in the United States.*

(The following table gradually appears with dates and miles:)

1830—	32	1880—	93,296
1840—	2,818	1890—	163,597
1850—	9,021	1900—	193,346
1860—	30,625	1910—	249,442
1870—	52,914	1920—	266,031

6. *Because it was vital to the growth of our country.*

(Map shows spread of our population.)

(Map of United States in black framework, white letters appear:)

1860—31,000,000

(Dotting indicates denseness of population at same time.)

1870—	38,000,000	1900—	76,000,000
1880—	50,000,000	1910—	92,000,000
1890—	62,000,000	1920—	105,000,000

(NOTE.—Shading increases gradually but changes at the same time that the title changes.)

7. *As heavier equipment became necessary, construction became more and more costly.*

(The following table appears, line by line:)

Railroad construction, average cost per mile (directly under other title)

1860—	\$33,000
1870—	60,000
1890—	84,000
1900—	62,000 prairie railroads cheaper
1920—	97,000

(Amount indicated by bar diagram.)

Table—weight of rails per yard—once 20 lb. now 120 lb.

(Diagram headed: "Rail cross-sections compared." Picture of two rails shown from end. Smaller one headed 1870; larger 1920. Underneath words appear: "Increase in weight 200 per cent.")

8. *Old time light roadbeds*

(View of section of roadbed.)

9. *Gave way to these*

(Modern freight yard. Another picture under this title also showing train.)

10. *The locomotive of 1860, weighed 15 tons—today 180 tons.*

(View of two locomotives side by side. Modern locomotive viewed from end and not side. Result, comparison not so obvious.)

(NOTE.—This is a double exposure picture. One of primitive engine probably taken from old photograph.)

(View of modern passenger station. Another double exposure showing on one side train of earlier make approaching, and on left, modern train.)

11. *The electric locomotive—weight 284 tons, length 112 feet.*

(Picture shows electric locomotive approaching. Another view showing locomotive in mountain pass viewed from above.)

12. *Trains now cover a thousand miles a day*

(View passenger terminal with two trains leaving.)

13. *And serve all parts of the country.*

(Map of United States headed, "Principal Railroads, 1920." Map is covered by network of lines indicating railroads.)

14. *In the Civil War the North had the advantage of more railroads to transport men and supplies.*

(View of eastern portion of United States with title to the right—*North*. Northern portion of country covered with network of lines representing railroads. Title—*South*—now appears, and railroads in South shown in same way.)

15. *In peace times, too, trade and commerce depend largely on railroads.*
(View of freight yard showing large number of freight cars. View taken from above showing tops of cars only.)
16. *Railroad builders have constructed great bridges, tunnels, and viaducts.*
(View of steel railroad bridge. View of same from side showing it is over a river. Train passes across—changes, and camera is placed in front of train. Passing through viaduct.)
17. *They have built railroads in places where horses could not go.*
(View of rocky pass in mountain. Railroad close to cliff.)
18. *Railroads now employ nearly two million people—almost one-fiftieth of the population of the United States.*
(Diagram showing two cubes. Small one headed "Railroad Employees." Larger one "United States Population.")
19. *Before railroads came this farm land was vacant. Today it is worth \$250 per acre.*
(View of reaper and binder cutting and binding grain.)

Table:

FARM LAND		CITY PROPERTY	
Average Value Per Acre		Average Value Per Acre	
1820	Now	1820	Now
\$1.25	\$80.00	\$500.00	\$5,000.00

20. *Railroad investments of 22 billion dollars made land value of 320 billion dollars possible in the United States*
(Animated graph, top line representing investments, lower representing land value.)
21. *And made possible our great industrial and commercial cities.*
(Panorama of city showing railroad in foreground.)
22. *Railroad economics—railroad revenue in 1920 was derived from:*

	Per Cent
Freight traffic.....	69.5
Passenger traffic.....	20.7
Miscellaneous.....	9.8
	100.0

23. *Railroad economics—railroad revenue and railroad expenses compared:*

	Revenue	Expenses
1890.....	\$1,052,000,000	\$ 692,000,000
1910.....	2,751,000,000	1,823,000,000
1920.....	6,225,000,000	5,826,000,000

24. *Railroad economics—railroad operating expenses in 1920 were as follows:*

	Per Cent
Wages.....	64
Fuel.....	12
Materials and Supplies.....	18
Miscellaneous.....	6
	100

25. *Cost of railroad operation compared:*

1890.....	\$ 692,093,971
1910.....	1,822,630,433
1920.....	5,826,197,474

26. *The failure of our railroad service would mean the destruction of our cities and the ruin of our farms.*

(Map headed "Dependent on Railroads." Map shows United States covered with network and following cities: Helena, Salt Lake City, Denver, Fort Worth, St. Paul, Birmingham, Atlanta.)

(Pointer points out heading of map and then points to each city in turn.)

27. *The marketing of our greatest products absolutely depends on railroads—for example:*

(Map headed "Steel Mill Locations." Dark spot at Chicago and Pittsburgh. Names of cities appear.)

(Words, *New York, Eastern Market*, appear. Words *San Francisco, Western Market*, appear. Line runs from San Francisco to Chicago, also from Pittsburgh to New York.)

28. *Early and modern transportation compared.*

(On same map appears "Early Transportation, 1830, 8 days; 1860, 43 hours.")

(Pointer points to early transportation, then follows line from Pittsburgh to New York and points to 1830—6 days. Then indicates 1860—43 hours. In western part of United States appear titles 1850—6 months; 1870—6 $\frac{3}{4}$ days. Pointer follows line from Chicago to San Francisco. Then points to towns shown above.)

(Title changes to "Modern Transportation." Words appear—1890—15 hours; 1920—10 $\frac{1}{2}$ hours. Pointer indicates title of map and then follows line from Pittsburgh to New York, then points to figures given above.)

(Words appear under San Francisco, 1890—4 days; 1920—72 hours. Pointer indicates title of map; follows from Chicago to San Francisco and then points to figures.)

(View of DeWitt Clinton's locomotive and cars with people dressed in early costumes. Modern locomotive and passenger train appears in background).

EXPERIMENT 1

Two comparisons were made between the film and another mode of presentation which was a substitute for the film in its entirety. In one case the comparison was made between the film and an oral lecture, and the other between the film and a reading lesson which was made up to contain the information contained in the film. In the lecture the teacher displayed before the class large maps, charts, and tables which were duplicates of the maps in the film. Three of the charts are

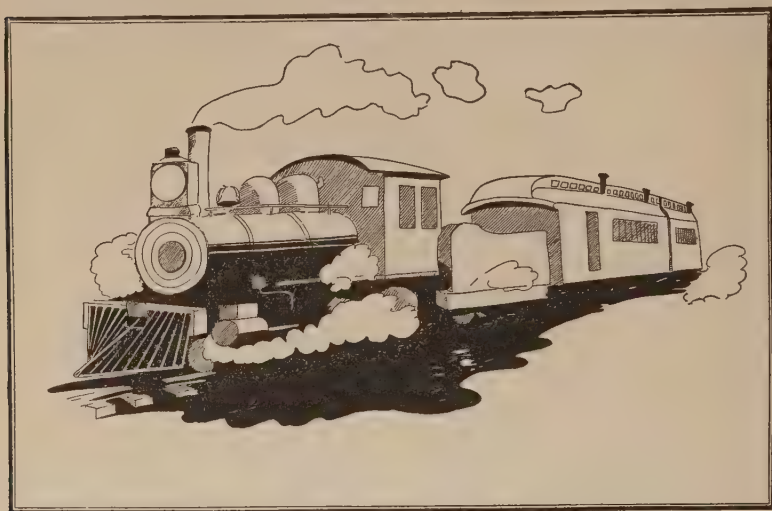


FIG. 1.—Illustration of wall chart used in the experiment with the film, *Railroads in the United States*.

reproduced by way of illustration. See Figures 1, 2, and 3. The picture of the early railroad is taken from the section of the film which follows subtitle No. 2. The diagram of the rails follows subtitle No. 7 and the map subtitle No. 26. These were referred to by the teacher in the course of the lecture. The lecture occupied the same length of time as the film.

In the second comparison, one group of pupils viewed the film twice, and the second studied the text above mentioned for thirty minutes. The nature of the reading lesson may be

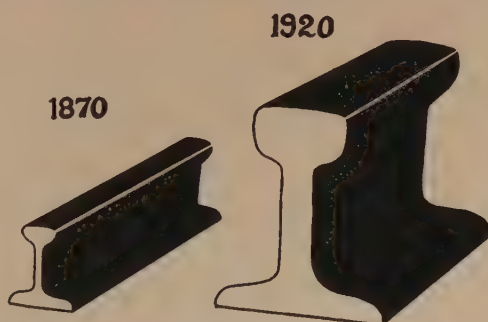
RAIL CROSS SECTIONS COMPARED**INCREASE IN WEIGHT 200%**

FIG. 2.—Illustration of wall chart used in the experiment with the film, *Railroads in the United States*.

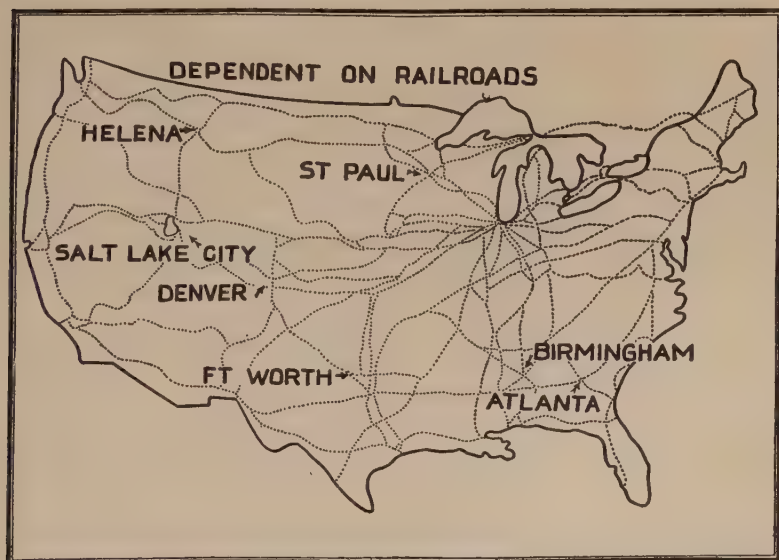


FIG. 3.—Illustration of wall chart used in the experiment with the film, *Railroads in the United States*.

gathered from the following extract, which is approximately one-quarter of the entire text.

RAILROADS IN THE UNITED STATES

The growth of railroads.—You have probably all traveled on a railroad and have seen one many times. You know there was a time when there were no railroads and people had to travel in other ways, by stage-coach or horseback, and so on. How long ago do you suppose that was? About one hundred years. The first railroads were built about 1820.

In the United States the railroads were built along the Atlantic Coast at the beginning because it was here where the people were. They were used first to haul coal and ore. You may see the location of the coal and iron fields on Map No. 1. The coal fields are shown by black shading and the iron fields by lighter shading. Notice that coal and iron fields are often near together, and that important fields of both coal and iron are near the Atlantic Coast. Mining railroads were built in 1828-30, and were located at the mining towns of Honesdale, Quincy, Chester, Carbondale, and Mauch Chunk. Notice the location of these places on Map No. 2.

From 1820 to 1840 railroads were also built at the large cities of Boston New York, Philadelphia, Wheeling, and Baltimore. The Baltimore and Ohio connected Baltimore and Wheeling in 1830. Follow this on Maps No. 3 and 4.

The railroads were extended from the Atlantic Coast toward the west and made it easy for settlers to follow the eastern pioneers. By 1850 the part of the United States east of the Mississippi River, and especially north of the Ohio River, was pretty well covered with a network of railroads as you see on Map No. 5. At this time 9,021 miles had been built. By 1860, just before the Civil War there were three times as many miles of railroads, or 30,625. Compare the map of 1860 (No. 6) with that of 1850. Down to 1900 each ten-year period saw more miles of railroad built than the period before. Notice the increase in mileage as it is shown in Table I.

RAILROAD MILEAGE BY DECADES

1830—	23	1880—	93,296
1840—	2,818	1890—	163,597
1850—	9,021	1900—	193,346
1860—	30,625	1910—	249,442
1870—	52,914	1920—	266,031

POPULATION BY DECADES

1860—	31,000,000	1900—	76,000,000
1870—	38,000,000	1910—	92,000,000
1880—	50,000,000	1920—	105,000,000
1890—	62,000,000		

After the Civil War in 1869, the first railroad to the Pacific Coast was completed. This was the Central and Union Pacific. The railroad was started at both ends and met at Ogden, Utah. Find it on Map No. 6.

The maps and charts which were not reproduced in this reading text were displayed in enlarged form on the wall of the room and the pupils were directed to refer to them. They were the same as those which were used in the lecture and which are illustrated above.

THE TESTS

Two tests were used in both comparisons, a completion and a multiple-answer test. Each consisted of twenty-five items. Each test is illustrated below by the first ten items.

RAILROADS IN THE UNITED STATES

[Fill in the blanks to make the correct answers]

1. The first railroads in the United States were built in the year ———.
2. The first railroads were used to haul ———.
3. Mining railroads were built at the cities ———, ———, ———, ———.
4. These were built in the years ——— to ———.
5. There were ——— miles of railroad in 1850.
6. The population of the United States in 1900 was about ———.
7. The cost of building railroads became $\left\{ \begin{array}{l} \text{greater} \\ \text{less} \end{array} \right\}$ because ———.
8. The early rails weighed ——— lbs. per yard; now they weigh ——— lbs.
9. The weight of rails is now ——— times as much as in 1890.
10. The cost of construction decreased in ——— because ———.

RAILROADS IN THE UNITED STATES

[Cross out incorrect answers]

1. In 1820 the railroads were $\left\{ \begin{array}{l} \text{at large cities of Boston, Philadelphia.} \\ \text{along Atlantic Coast.} \\ \text{United States northeast of Mississippi.} \\ \text{from Atlantic to Pacific coasts.} \end{array} \right.$
2. By $\left\{ \begin{array}{l} 1860 \\ 1850 \\ 1883 \\ 1869 \end{array} \right\}$ there were several railroads from the eastern states to the Pacific Coast.
3. The first railroads were used to haul $\left\{ \begin{array}{l} \text{wood.} \\ \text{coal.} \\ \text{gold.} \\ \text{iron} \\ \text{silver.} \end{array} \right.$

4. The Baltimore and Ohio connected Baltimore and Wheeling in $\left\{ \begin{array}{l} 1820. \\ 1840. \\ 1800. \\ 1830. \end{array} \right.$
5. There were $\left\{ \begin{array}{l} 2,818 \\ 9,021 \\ 52,914 \\ 30,625 \end{array} \right\}$ miles of railroads in 1850.
6. Railroads were first connected with mines about $\left\{ \begin{array}{l} 1800. \\ 1828. \\ 1840. \\ 1820. \end{array} \right.$
7. The first railroad built from the Pacific and Atlantic coasts met
at $\left\{ \begin{array}{l} \text{Chester.} \\ \text{Baltimore.} \\ \text{Ogden.} \\ \text{Wheeling.} \end{array} \right.$
8. In 1865 locomotives weighed $\left\{ \begin{array}{l} 15 \\ 180 \\ 284 \end{array} \right\}$ tons.
9. The rails weigh now per yard $\left\{ \begin{array}{l} 2 \\ 3 \\ 4 \\ 5 \\ 8 \end{array} \right\}$ times as much as the earlier ones.
10. The cost of construction per mile in 1900 was $\left\{ \begin{array}{l} \$33,000. \\ 97,000. \\ 63,000. \\ 84,000. \end{array} \right.$

The data on which the pupils of the parallel groups were matched in Experiment 1 are shown in Tables I and II.

TABLE I
DATA WHICH FORMED THE BASIS OF MATCHING

MOTION PICTURE GROUP			LECTURE GROUP		
Age	Sex	Intelligence Score	Age	Sex	Intelligence Score
12-9.....	f	65	12-11.....	m	72
12-7.....	m	80	12-8.....	m	75
12-9.....	f	72	12-8.....	f	66
12-9.....	f	74	12-5.....	m	75
13-4.....	m	75	13-6.....	m	76
13-3.....	m	77	13-1.....	m	74
13-2.....	f	63	13-5.....	f	64
13-5.....	f	85	13-5.....	m	89
13-7.....	f	77	13-7.....	m	75
13-2.....	m	62	13-1.....	f	61
13-11.....	f	76	14-1.....	m	75
14-11.....	f	85	14-9.....	m	89
13-5.....	f	62	13-1.....	f	67
15-2.....	m	94	14-11.....	m	101
13-7.....	f	60	13-11.....	m	68
13-7.....	f	68	13-10.....	m	73

TABLE II
DATA WHICH FORMED THE BASIS OF MATCHING

MOTION PICTURE GROUP			STUDY GROUP		
Age	Sex	Intelligence Score	Age	Sex	Intelligence Score
13-0.....	m	85	12-11.....	m	87
13-10.....	m	93	13-7.....	f	100
14-11.....	m	97	14-9.....	f	93
14-0.....	f	54	14-4.....	m	51
14-4.....	m	58	14-8.....	m	57
14-8.....	f	84	14-9.....	f	76
13-5.....	f	79	13-0.....	f	76
14-1.....	m	62	14-1.....	m	62
14-0.....	m	72	13-11.....	f	72
14-3.....	f	61	14-2.....	f	54
16-6.....	f	55	16-3.....	f	47
15-10.....	m	66	15-11.....	m	59
14-10.....	m	75	15-0.....	f	70
15-6.....	m	68	15-7.....	m	59

RESULTS OF COMPARISON OF THE FILM WITH LECTURE AND WITH STUDY

The results of Experiment 1 are shown in Table III. The graphic representation of these results are given on page 41.

The table requires little comment. In the first comparison the lecture appears to have been slightly more effective than the motion picture. The difference in favor of the lecture is somewhat greater than the superiority of the lecture group in intelligence.

In the second comparison the difference in effectiveness is to the advantage of the motion picture group but the intelligence of this group is superior in about the same degree.

TABLE III
AVERAGE SCORES MADE BY THE MOTION PICTURE AND THE LECTURE
AND STUDY GROUPS (CONDON SCHOOL)

Group	No. Cases	Intelligence Test	Score in Completion Test	Score in Multiple-Answer Test
Motion picture.....	16	73.4	2.6	9.4
Lecture.....	16	75.0	3.3	9.9
Motion picture.....	14	71.7*	2.7	10.5
Study.....	14	68.8	2.3	9.1

* Omitting one pupil who was absent.

Both lecture and the study of the printed text, therefore, yield as much information as does the motion picture film.

The low scores of all the groups indicate that the subject-matter in the film, as well as in the lecture and the reading text, is much too condensed. It was necessary to condense the material in the parallel methods in order to make them comparable to the film. This undue condensation is ground for strong criticism of this particular film.

EXPERIMENT 2

The preceding experiment has dealt with a comparison between the film and some other mode of presentation which

was used as a substitute for the entire film. In the following three comparisons, a part of the film was extracted or cut out and was presented in some other fashion, and the remaining part of the film was shown with it. This presentation, which will be called "mixed" presentation, was then compared with the showing of the entire film to the parallel group. In the first of the three comparisons, the mixed group saw all of the film except the maps. These were shown on large sheets of cardboard which were hung up in the room. When the place in the film was reached which was occupied by the map, the lights in the auditorium were switched on and the map was explained by an instructor. The film group which was compared with this mixed group, is designated as A₁ and the mixed group A₂. In a second comparison, which is represented by groups B₁ and B₂, the maps and charts were cut out of the film and were presented on large sheets of cardboard and explained by the teacher to Group B₂, in the same fashion as with Group A₂. Group B₁ saw the entire film. In the third comparison the maps, charts, and tables were cut out from the film, and were shown as before, with explanatory comments to one group. The groups which featured in this comparison were C₁ and C₂. The purpose of this progressive elimination of parts from the film was to determine if possible whether certain specific types of material would be shown better by the lecture-chart method than by the film method.

The three comparisons above mentioned were made with groups of children taken from the fifth, sixth, seventh, and eighth grades of the Angell School in Detroit. Each of the pairs which were used as parallel groups were matched as nearly as possible in grade, age, sex, and intelligence in the same manner as is shown in detail in the first comparison. The detailed tables which formed the basis of matching in the remainder of the experiment are omitted.

The film and the tests which were used are the same as those described in the previous section.

RESULTS

The results of the experiments are given in Table IV. They are shown graphically on page 41. The table shows, for example, that in the first comparison, in which only the maps were cut out of the film, the film group made a slightly better score than the mixed group. The rest of the table may be read in the same way.

It appears from the result of these comparisons that the group which was shown the film except for the maps, and in which the maps were shown by the teacher, made a score which was

TABLE IV
AVERAGE SCORES OF THE FILM GROUPS AND THE GROUPS
WHICH WERE GIVEN MIXED PRESENTATION IN THE
EXPERIMENT WITH THE RAILROAD FILM
(ANGELL SCHOOL)

Group	Number	Score in Intelligence Test	Score in Completion Test	Score in Multiple- Answer Test
A1*.....	17	53.5	2.8	8.8
A2.....	17	53.8	2.2	8.4
B1.....	32,29	70.0	4.8	9.9
B2.....	31	70.3	5.1	10.3
C1.....	25	60.7	4.0	10.2
C2.....	25,24	60.5	5.9	11.1

* A1, B1, and C1 are the film groups. Groups A2, B2, and C2 are mixed groups.

slightly inferior to that of the film group. The other two mixed groups, however, made a score superior to the film groups. The group to which the maps and the charts were shown in lecture form made a clearly superior score, and the one to whom the maps, charts, and tables were shown apart from the film made a score which was still more superior. If we may rely upon these three comparisons, we may say that the mixed groups did better in proportion to the amount of material which they were shown in lecture form.

Taking the two experiments together, it appears that the sort of material which constituted the chief part of this film can

be presented fully as well if not better by the lecture, supplemented by charts, diagrams, and tables as displayed on the wall, or by reading, than in a motion picture film.

EXPERIMENT 3

The first two of the three comparisons were repeated in the Miller School with pupils in the eighth grade. In the first comparison, which was made with Groups A₁ and A₂, the maps were eliminated from the film and presented by the teacher with the aid of large charts made from the film. In Groups B₁ and B₂ the maps and charts were presented by the teacher and the remainder of the material was shown by means of the film.

Three tests were employed. The completion test and the multiple-answer test were the same as those which were used in the preceding parts of the experiment. The general test consisted of a series of questions which were designed to be easier than the other tests so that higher scores would be made. It was thought that such a test might be more sensitive to differences in instruction than one in which the median score was a small percentage of the possible score.

The average scores of the various groups in the Miller School are shown in Table V and in the figure on page 41. As in the Angell School, the scores made by the groups to which the mixed presentation was made were on the whole higher than the scores of those who saw the entire film. In this school the differences are much more pronounced than in the other two schools. In each case, furthermore, the group to which the larger share of the material was presented in lecture form by the teacher, Group B, exhibited greater superiority than did the other group, Group A.

The experiment seems clearly to support the conclusion that, to say the least, there is no advantage in presenting collections of facts such as are usually exhibited in maps, tables, and diagrams, and which are contained in the railroad film, by means of motion pictures. In fact, the motion picture seems to be a disadvantageous mode of presenting such material, quite apart from the

expense of producing or the inconvenience of distributing films. The oral lecture, accompanied by maps, tables, and diagrams is

TABLE V

AVERAGE SCORES OF THE FILM GROUPS AND THE GROUPS WHICH WERE GIVEN MIXED PRESENTATION IN THE EXPERIMENT WITH THE RAILROAD FILM (MILLER SCHOOL)

GROUP	NUMBER	SCORE IN INTELLIGENCE TEST	SCORE IN SUBJECT-MATTER TEST
General Test			
A1*.....	22	67.3	29.5
A2.....	24	65.2	27.0
B1.....	22	68.0	25.3
B2.....	28	65.1	30.4
Completion Test			
A1.....	21	67.0	4.4
A2.....	19	67.1	6.7
B1.....	20	67.9	2.1
B2.....	26	64.5	5.7
Multiple-Answer Test			
A1.....	17	67.5	10.3
A2.....	21	67.5	12.3
B1.....	20	67.9	8.3
B2.....	26	64.5	12.0

* The A1 and B1 groups are the film groups; Groups A2 and B2 are mixed groups.

superior, both in effectiveness and convenience, to convey information of a more or less general or abstract sort.

CHAPTER VI

THE EFFECTIVENESS OF THE MOTION PICTURE USED AS AN INTRODUCTION OR AS THE SUMMARY

A. P. HOLLIS

INTRODUCTORY

Experiments with educational motion picture films are subject to certain difficulties inherent in the nature of the materials that have to be used. Some of these may be pointed out as follows:

1. SELECTING AND SECURING SUITABLE CLASSROOM FILMS

Films produced for the classroom, or those produced for the general public, but found adapted to classroom use, are very few. Of those produced for the classroom, a still smaller number have been planned by experienced educators who have collaborated with experienced producers. Sometimes one, and sometimes the other have acted, but rarely have the two acted together. The reasons are well known and need not be stated here. The best of the classroom films are still far from perfect, and two years from now, these best would probably be ranked as medium or even poor. To give the films a fair chance at all with the better perfected oral methods, unusual care should be given to selecting only the best.

2. SECURING THE CO-OPERATION OF THE SCHOOL OFFICIALS

It is no light thing for a school superintendent to arrange for a series of experiments in a city system. Modern practice requires intelligence ratings, and implies a special officer for the work. Schedules must be arranged so as not to interfere with the regular school program, the right teachers must be enlisted for co-operation, and suitable arrangements have to be made for projection. The schools are frequently far apart, sometimes in

different cities, and experimenters usually have other duties from which the time must be spared.

3. PROJECTION

It is essential in all experiments that the film should receive standard projection. A broken film, irregularities with current, switches, focusing, illuminants, and other mechanical arrangements would cripple the value of the film lesson in much the same way as if, in the oral lesson, the teacher should suddenly start to stutter, or should faint; or the stove should refuse to light in the cooking lesson.

In these experiments, the projection was standard at all times; there were no delays worth mentioning, or accidents due to machine troubles. Classrooms would have furnished a more normal atmosphere for instructional purposes than did the school auditoriums used, but instruction was as frequent in them as entertainment, and the variation was not serious.

The cities selected (Detroit and Oak Park) were those where proper equipment was known to exist and where co-operation was assured. Unexpected difficulties were experienced, however, in putting the details of co-operation into effect. The delays were mainly concerned with schedules, securing control groups of equal ability, and accurate and complete age and intelligence ratings.

In all cases a serious attempt was made to keep all important factors constant, except the one under examination. Thus the teachers, rooms, time, and grade were the same for all the paired groups; and the age and intelligence ratings were approximately equal. But it is realized that a teaching problem involves a complex of many factors impossible of absolute control, so that even the "constants" are variables—and are very far removed from the mechanical identity possible in a physics laboratory. With such shifting data, it seems inappropriate to employ elaborate mathematical computations, whose niceties give a false impression of the accuracy of the data. For the most part, simple averages (means) were used as being most familiar to

the teachers, and most appropriate to the degree of accuracy exhibited in the data. The completion tests were scored by points, and the "Yes-and-No" tests by subtracting wrongs from rights.

Several months' work has been condensed in the few tables in this chapter and in chapter x, which are presented to show the results of the experiments. The tables tell pretty nearly their own story, so that only brief comments on the experiments are necessary.

EXPERIMENT 1

This experiment was to determine if, in a two-lesson unit, a film used as introduction to a topic improved the quality of instruction as tested by the written responses of the pupils. The topic of the lesson was "Pure Food," and the introductory film was *Milk as Food* from the Ford Motion Picture Laboratories. Here the introduction was not a broad general view, but a typical instance visualized. The film was run by the experimenter for fifteen minutes without comment to children of Grade VIII A in Detroit and Oak Park, in class units varying from twenty to to thirty-eight pupils. The showing was followed immediately with the presentation by the teacher, for twenty minutes, of further facts on the subject, based on material in specified pages of Trafton's *Science of Home and Community*. The teacher was given a preview of the film before the lesson was given, and was handed both a general outline of the lessons, and a synopsis of the film subtitles.

The second day the teacher taught the same group, orally, further material on diseased and adulterated food designated in Trafton's text, the lesson occupying thirty-five minutes as on the first day.

The third day, "Yes-and-No" and completion tests of twenty questions each were given for ten minutes each. The averages of the scores made on these tests are what are presented in the tables following.

In each case, to a control group of VIII A pupils, the same teacher for the same length of time, taught identical material,

except that no film was used, the facts portrayed on the film being given in an oral introduction.

During the computations, the class rolls were reduced by selecting only those papers written by pupils who were closely

TABLE I

COMPARATIVE SCORES* OF CLASSES TAUGHT (1) WITH A FILM AS INTRODUCTION, AND (2) WITH ORAL INTRODUCTION

SCHOOLS	COMPLETION-TEST SCORES					"YES-NO" TEST SCORES					AVERAGE OF TWO DIFFERENCES
	Film as Introduction		Oral Introduction		Difference	Film as Introduction		Oral Introduction		Difference	
	No. Pupils	Scores and Percentages	No. Pupils	Scores and Percentages		No. Pupils	Scores and Percentages	No. Pupils	Scores and Percentages		
Average Scores of All Papers in Each Group											
Detroit: W. Group..	31	14.22 71.10	31	13.50 67.50	.72 3.60	31	9.61 48.05	31	7.67 38.35	1.94 9.70	1.33 6.60
Detroit: L. Group...	21	11.78 58.90	33	10.54 52.70	1.24 6.20	22	9.27 46.35	34	8.06 40.30	1.21 6.05	1.22 6.30
Oak Park: H. Group..	26	14.80 74.90	38	13.40 67.00	1.40 7.00	26	14.10 70.50	39	12.86 64.30	1.24 6.20	1.32 6.60
Oak Park: W. Group..	20	13.60 68.00	25	13.17 68.85	.43 2.15	20	10.06 50.30	26	12.07 60.35	- 2.01 -10.05	-1.58 -7.90
Average Scores of Matched Pairs Selected from Each Group above on the Basis of Age and Intelligence Ratings											
Detroit: W. Group..	10	13.90 69.50	10	12.60 63.00	1.30 6.50	10	.84 42.00	10	6.00 30.00	2.40 12.00	1.85 9.20
Detroit: L. Group...	10	11.30 56.50	10	10.75 53.75	.55 2.75	10	9.40 47.00	10	8.04 40.20	1.36 6.80	.95 4.80
Oak Park: H. Group..	11	14.50 72.50	11	13.60 68.00	.90 4.50	11	14.90 74.50	11	12.01 60.05	2.89 14.00	1.89 9.80
Oak Park: W. Group..	10	13.90 69.50	10	14.35 71.75	- .45 -2.25	10	11.10 55.50	10	13.50 67.50	- 2.40 -12.00	-2.85 -7.13

* The scores were reduced to percentages and placed under the point scores.

matched on the basis of age and intelligence ratings. These papers were averaged separately and compared with those of the larger class groups. The difference in the scores between the ordinary unmatched groups of the same grade and selected

pupils from these grades, matched by age and intelligence, is very slight. In Experiment 1, the difference in percentage between the matched and unmatched groups is .73 per cent. That is, if we take the matched group results instead of the unmatched, the percentage of superiority in ability due to the film is 4.17 per cent rather than 4.9 per cent.¹

Table I shows that for these pupils, in three schools, the film introduction gave a superiority of 6.5 per cent over the oral introduction. The fourth school listed in the table (Oak Park—W. Group) is an exception to the other three, and gives a score of 7.9 per cent in favor of the oral introduction. A comment on the procedure in this school is given at the close of the discussion of Experiment 2. The average of the four schools is 4.9 per cent in favor of using the film as introduction.

EXPERIMENT 2

In Experiment 2, the problem was different from that of Experiment 1. While the film was used as introduction in both experiments, in Experiment 2, it is matched against itself as a summary, and the question at issue is: Granted that a film should be used in this lesson, should it be used as an introduction to the lesson, or as a summary?

The subject chosen for the lesson was "Mosquitoes," a topic in general science for Grade VIII A. The chief reason this topic was chosen was because the film, *The Mosquito*, issued by the Society for Visual Education, seemed to be especially well adapted to classroom use. The motion elements in the subject were adequately represented, the photography was clear and true, and the producers furnished synopses and pedagogical aids to accompany the film.

Matched groups, taught under uniform conditions by the same teacher, were used as in Experiment 1. Each lesson occurred on two days in succession, and occupied thirty-five minutes each day. One group of children was shown the film at the beginning of the two-day lesson unit, while the other group was shown the film at the close of the lesson. Synopses of the film, outlines of

¹ The averages cited in the text are made up from the original data.

the lesson plan, and direction sheets were handed the teachers beforehand, as in Experiment 1. The material on the mosquito other than that shown on the film was taught from indicated pages in Trafton's *Science of Home and Community*. Completion

TABLE II
COMPARATIVE SCORES OF VIII A PUPILS TAUGHT (1) WITH A FILM AS INTRODUCTION, AND (2) WITH A FILM AS SUMMARY

SCHOOLS	COMPLETION TEST SCORES					"YES-NO" TEST SCORES					AVERAGE OF TWO DIFFERENCES
	Film as Introduction		Film as Summary		Difference	Film as Introduction		Film as Summary		Difference	
	No. Pupils	Scores and Percentages	No. Pupils	Scores and Percentages		No. Pupils	Scores and Percentages	No. Pupils	Scores and Percentages		
	Average Scores of All Papers in Each Group										
Detroit: F. Group...	35	10.30 51.50	31	9.75 48.75	.55 2.75	34	7.12 35.60	31	5.93 29.65	1.19 5.95	.87 4.35
Oak Park: E. Group...	22	9.46 47.30	21	9.09 45.45	.37 1.85	21	9.50 47.50	21	7.80 39.00	1.70 8.05	1.03 5.18
Oak Park: H. Group..	36	9.02 45.10	29	7.01 35.05	2.01 9.95	36	9.50 47.50	29	6.60 33.00	2.08 14.50	2.05 12.23
Oak Park: W. Group..	20	8.06 40.30	24	8.08 40.40	— .02 — .10	20	8.80 44.00	23	7.90 39.50	1.01 6.50	.49 3.20
	Average Scores of Matched Pairs Selected from Each Group Above on the Basis of Age and Intelligence Ratings										
Detroit: F. Group...	9	10.70 53.50	9	10.20 51.00	.50 2.50	9	9.33 46.65	9	7.00 35.00	2.33 11.65	1.41 7.08
Oak Park: E. Group..	11	10.00 50.00	11	9.50 47.50	.50 2.50	11	9.20 46.00	11	7.40 37.00	1.80 9.00	1.15 5.80
Oak Park: H. Group..	10	8.60 43.00	10	7.00 35.00	1.60 8.00	10	8.40 42.00	10	6.80 34.00	1.60 8.00	1.60 8.00
Oak Park: W. Group..	10	8.60 43.00	10	7.25 36.25	1.35 6.75	10	8.80 44.00	10	6.80 34.00	2.00 10.00	1.67 8.38

and "Yes-No" tests occurred during the last half of the second lesson. The completion test was scored by points, and the "Yes-No" test by the method of rights minus wrongs, as in Experiment 1. Later, these scores were reduced to percentages and placed under the point scores in Table II, which contains the results of the experiment.

The averages of the scores made by the competing groups, in percentages, show that in this case, for the larger groups, the advantage is 6.24 per cent for the film as introduction, and for the smaller more strictly matched groups the advantage is 7.32 per cent for the film as introduction rather than as summary.

A possible explanation for the uniformly superior results shown by the film when used as introduction as against summary is that the film shown at the outset sets up a greater interest in the topic than the oral introduction, arouses more questions, and therefore stimulates closer attention to the subsequent lesson material. The same explanation may account for the superior results in Experiment 1, where the film is used as introduction, against the results yielded where no film at all was used in the lesson.

CHAPTER VII

THE USE OF A MOTION PICTURE FILM TO TEACH POSITION AND PENHOLDING IN HANDWRITING

FRANK N. FREEMAN, LENA A. SHAW, AND D. E. WALKER

PROBLEM

This experiment was intended to throw light upon the general question of the value of motion pictures as means of teaching how to perform an overt act of skill. There are a number of cases in which such acts of skill are taught in the schools, and a great many such acts are learned outside the school, in the fields of industry, business, or sport. Skill of movement is acquired, for example, in the unspecialized handwork of the kindergarten and primary grades, in free-hand drawing and painting, in shopwork and mechanical drawing, in laboratory work, in dancing, gymnastics and athletics, in oral speech, and in handwriting. In another experiment the use of motion pictures in teaching handwork—making a paper box and making a reed mat—was investigated. In this experiment handwriting was selected as the subject of study.

We may consider for a moment the psychology of acquiring an act of skill, for the purpose of forming a judgment as to the point at which we may expect instruction to be effective. The numerous experiments upon learning acts of skill indicate clearly that instruction of any kind has very marked limitations. The learner discovers how to perform the act largely by the method of trying over and over again, and gradually, without knowing exactly how, improving in the performance. The learner measures his improvement chiefly by the fact that he attains a better and better objective result, rather than by the fact that he recognizes an improvement in the manner of his performance. This fact sets certain limits to the effectiveness of any method of instruction whatever.

Within the limits which are set by the general nature of the learning process, there is room for instruction to operate and to influence the rapidity of learning and the degree of skill which the learner finally attains. We assume, of course, to begin with, that the function of instruction is to set the task. It indicates to the pupil *what* is to be done. The problem is, how effective may instruction be in going beyond the point of setting the task and indicating to the pupil *how* he is to perform the task which is set before him? At what points and to what extent is instruction effective in influencing the manner of performance?

The two important aspects of the manner in which an act is performed are position and mode of execution. By position is meant the bodily attitude which the individual assumes when he is prepared to perform the act, the way an object is held, or the attitude, during the movement, of the parts of the body which do not participate in the movement. By mode of execution is meant the path through which the movement goes, or the time relations of the movement. In a complex act the mode of execution involves the relation between various paths of movement and the time relations of the various movements to each other.

If motion pictures are effective, then, as means of giving instruction in an act of skill, it is because they are effective in indicating to the learner the positions he should assume, the way he should hold the objects he is dealing with, and the paths and time relations of the movements which he should make. If motion pictures are more effective than other methods, it is because they indicate position or mode of execution more clearly than do the other methods.

We might suppose that motion pictures are effective means of indicating position on account of two circumstances. First they can give to an entire class the view of performer's position which is to be gained by an observer who is placed in the most advantageous situation, because the camera can be put in such a situation. This is an advantage which motion pictures have in common with still pictures. In addition to this, however,

motion pictures can exhibit good positions in immediate contrast with bad positions, by showing a person in the act of shifting from the one position to the other. In this way the characteristics of the good position are brought out by setting it in contrast with poor position.

We might expect the mode of execution of a movement to be shown with especial clearness by motion pictures because the movement can be exhibited to a group from the most advantageous point of observation. It can also be shown magnified in size. Furthermore, a number of different examples can be shown in succession, a given section of the movement may be isolated for special examination or the same movement may be repeated over and over. If a minute analysis of the movement is required it can be shown at reduced speed. This latter device was not employed in these experiments because it did not seem to be necessary.

Handwriting was chosen as the subject of study in the present experiment because the writer had already made an investigation of the effectiveness of different positions and types of movement in handwriting which gave evidence concerning those which are the more advantageous. Incidentally, motion picture photography had been used in making this investigation. It was therefore a natural next step to produce a film showing good positions in contrast with poor positions, and to try out this film as a means of instruction.

The specific problem of this experiment, then, was to discover what improvement may be produced in children's position in handwriting by the use of a motion picture film of the character above described in comparison with other modes of instruction.

PLAN OF THE EXPERIMENTS

The general plan of the experiments was to make the comparison of the film and of the other methods by using them in the instruction of parallel groups of children. One group of children was shown the film and the other group was instructed in position by some other method. In one of the experiments the

groups were small, being twenty-two and twenty-six in number respectively, but the film group and the non-film group were carefully matched on the basis of their rank in writing position. In the other experiment the number of children was large, being 1,472. In this case the individuals of the groups were not matched beforehand, the large number of cases making this unnecessary.

In both experiments the procedure was first to score the children of the parallel groups in the various aspects of writing position. This scoring was done by means of a specially constructed score card to be described below. The groups were then given the instruction by means of the motion picture film or by the method to be compared with the film. Finally all the groups were scored again, and the progress which they had made was compared.

The comparison of the gain made by the parallel groups was made in terms both of the total number of points in score and also in terms of the changes which appeared in the individual items of position, that is, position of the head, body, arms, or hand.

THE SCORE CARD FOR MEASURING POSITION

The score card was designed to serve as a means of obtaining an objective measure of the extent to which the children who were the subjects of the experiment approached the standard in position, and the gain they made under instruction. The first step in constructing such a score card was to determine what the standard position is. Two bases were employed from which were derived the principles of standard position. The first basis was hygiene and the second efficiency in writing. The position of the head and of the body which were regarded as standard are those which are commonly considered to have an important bearing upon the health of the writer. That this standard position of the head and body is also correlated with efficiency was discovered in the course of the experiment. The position of the arms and hand which was regarded as standard was

derived from a comparison of the position of good and poor writers which was made in a previous investigation.¹

After the general features of standard position had been determined upon, a tentative classification of positions to represent different degrees of excellence and a system of scoring were worked out. This first tentative scale gave a total possible score of 32 points. This tentative scale was used in the Evanston experiment and in preliminary tests in Detroit. On the basis of these preliminary tests minor revisions were made in the classification and scoring and the accompanying score card was finally adopted.

SCORE CARD FOR TESTING POSITION IN HANDWRITING

NAME _____
 DATE _____
 GRADE _____

Body posture

Direction faced:	Possible Score	Score
Facing desk squarely..... 3	3	
Turned slightly 15°..... 2		
Turned to side..... 1		

Erectness:

Erect..... 3	3	
Fairly erect..... 2		
Badly slumped..... 1		

Head

Reasonably upright..... 3	3	
Turned or bent moderately..... 2		
Badly turned or bent..... 1		

Arms

Both arms resting on desk..... 2	2	
One arm only on desk..... 1		
Elbows approximate symmetrical..... 2	2	
Elbows markedly unsymmetrical..... 1		
Right forearm at right angles to line of writing 2	2	
Right forearm 15 per cent or more off from right angle..... 1		

¹ Frank N. Freeman, *The Handwriting Movement*, chap. iv. University of Chicago Press, 1918.

Hand		Possible Score	Score
Supinated not more than 45 per cent.....	3	3	
Intermediate position.....	2		
Supinated more than 45 per cent.....	1		
Supported on nails or last joint of fingers...	3	3	
Intermediate position.....	2		
Supported on side or base of hand.....	1		
Finger on penholder well below the thumb..	3	3	
Finger opposite the thumb.....	2		
Finger above the thumb.....	1		
Loose grasp.....	3	3	
Moderately tight grasp.....	2		
Tight grasp.....	1		
		—	
		27	

In the course of the experiment some light was thrown on the validity of the principles on which the score card is based and on the possibility of securing reliable measurements by its use. The evidence on these points was secured by a comparison of the scores in position made by the good and the poor writers in the Detroit experiment.

The comparison of the scores in position of the good and poor writers is given in Table I.

In this table the scores of the good writers are given in the first four columns of figures and the scores of the poor writers in the next columns. In the fourth column of each division of the table are shown the percentages of the group who fall into the various classes indicated by the descriptions of the left. These descriptions follow the order of the topics on the score card. Thus the first three lines under the heading *Body* represent scores 3, 2, and 1 in the position of the body, with reference to whether or not it faces the desk. The table indicates that of the good writers 93 per cent faced the desk squarely, while of the poor writers but 86 per cent faced the desk squarely. The difference between these percentages is given in the next column. The figures in this column are to be interpreted as meaning that 7 per cent more good than poor writers were given the highest

score in the first type of body position, 6 per cent fewer received the second score, and 1 per cent fewer received the lowest score.

The differences expressed by these last-mentioned figures are represented graphically on Figure 1. The interpretation of this diagram may be illustrated by reference to the upper division.

TABLE I

POSITION	GOOD WRITERS				POOR WRITERS				DIFFERENCE COLS. 4 AND 8	LEFT-HANDED WRITERS			
	IVA	VIA	Total	Per- cent- age	IVA	VIA	Total	Per- cent- age		IVA	VIA	Total	Per- cent- age
Body:													
Facing desk....	83	30	113	93	55	22	77	86	7	1	4	5	25
Turned slightly.	6	2	8	7	7	5	12	13	-6	4	3	7	35
Turned to side..	1	0	1	0	1	0	1	1	-1	5	3	8	40
Body:													
Erect.....	77	28	105	86	45	21	67	74	12	0	3	3	15
Fairly erect....	13	4	17	14	17	6	23	25	-11	9	7	16	80
Slumped.....	0	0	0	0	1	0	1	1	-1	1	0	1	5
Head:													
Upright.....	56	19	75	61	32	14	46	51	10	1	4	5	25
Turned slightly.	30	11	41	34	25	12	37	41	-7	6	3	9	45
Turned much..	4	2	6	5	6	1	7	8	-3	3	3	6	30
Arms:													
Both on desk...	85	29	114	93	57	26	83	92	1	4	9	13	65
One on desk...	5	3	8	7	6	1	7	8	-1	6	1	7	35
Arms:													
Symmetrical...	74	30	104	85	45	21	66	73	12	2	6	8	40
Unsymmetrical.	16	2	18	15	18	6	24	27	-12	8	4	12	60
Arms:													
Square with....	65	26	91	75	38	22	60	67	8	0	3	3	15
Not square....	25	6	31	25	25	5	30	33	-8	10	7	17	85
Hand:													
Nearly level...	40	11	51	42	14	12	26	29	13	2	1	3	15
Turned slightly.	35	18	53	43	32	14	46	51	-18	5	4	9	45
Turned far....	15	3	18	15	17	1	18	20	5	3	5	8	40
Hand:													
On fingers.....	21	11	32	26	6	9	15	17	9	1	1	2	10
Partly on joint.	38	16	54	44	25	15	40	44	0	6	2	8	40
On hand.....	31	5	36	30	32	3	35	39	-9	3	7	10	50
Hand:													
Finger below...	20	11	31	25	13	7	20	22	3	1	2	3	15
Finger opposite.	64	19	83	68	43	19	62	69	-1	6	6	12	60
Finger above...	6	2	8	7	7	1	8	9	-2	3	2	5	25
Hand:													
Loose grasp....	18	13	31	25	5	13	18	20	5	0	2	2	5
Moderate grasp	43	18	61	68	25	9	34	38	30	5	4	9	45
Tight grasp....	29	1	30	7	33	5	38	42	-35	5	4	9	45
Number of pupils.	90	32	122	.....	63	27	90	.....	.....	10	10	20	.....

The titles at the left indicate that the upper main division gives a record of body position, and that the upper half of this division deals with the direction in which the body faces. The bar diagrams, then, show that more of the good writers face the desk squarely than of the poor writers, and conversely that more poor writers turn the body slightly or markedly to the side.

In general, the better positions are indicated by the upper bar in each division and the poorer positions by the lower bar. If, then, the upper bar extends to the right of the vertical line it

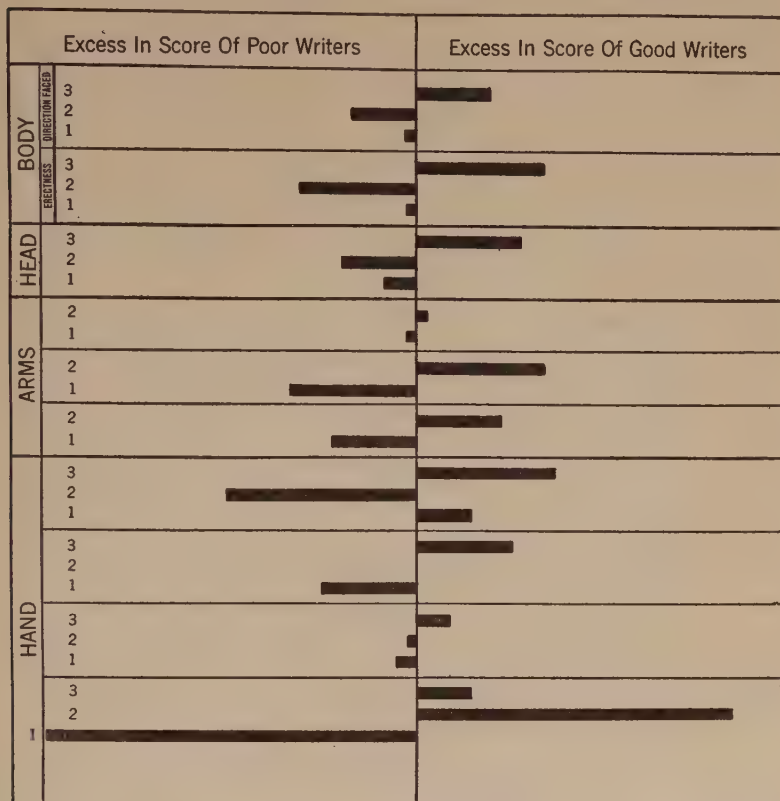


FIG. 1.—The difference in the percentage of the various scores in position received by the good writers and the poor writers. An excess in the score of good over poor writers is represented by a bar extending to the right of the vertical line. An excess in the score of the poor writers is represented by a bar extending to the left.

indicates that the good writers assume better position than the poor writers.

It appears from an inspection of the entire diagram that the good writers excel the poor writers in position in all but two

features of position. The two exceptions are the first type of arm position and the third type of hand position. The good writers do not excel the poor writers in the proportion of these who place both arms on the desk because the proportion of both groups whose position is satisfactory is so high—92 per cent and 93 per cent. The proportion of pupils who place the index finger below the thumb on the penholder is nearly the same in the two groups, apparently because this item of position is not a significant one. With these exceptions, the results indicate that the attempt to find effective methods of teaching position is worth while, because position is related to the quality of the pupils' writing.

Incidentally, in making the test, the scores in position of twenty left-handed pupils were tabulated. They are shown in the last four columns of Table I. This table shows that the position assumed by left-handed pupils is clearly inferior. Whether this inferiority is due to the inherent conditions of left-handed writing or to the fact that the left-handed pupils have not been instructed in the type of position which is adapted to their requirements is not indicated by the results of this test.

THE FILM AND ITS PRODUCTION

The description of the construction of the score card indicates the solution of the first problem which was faced in planning the film, namely, the determination of the aspects or features of position which should be shown. The major part of the film contained pictures of the positions which are indicated in the titles of the score card. In each case an example of good position was shown, and following this, an example of poor position. One aspect of movement, which is related to position, was also shown at the end of the film.

The primary aim of the film is to show the children as clearly as possible what good position and poor position are in detail, by presenting to them clear pictures of good and poor position and of the transition from good to poor position, and by the use of clear and simple subtitles which serve to call the attention of

the children to the aspects of position which the picture is designed to illustrate. It was expected also that the sight of examples of good in contrast to poor position would cause the pupils to admire good position and lead them to try to adopt it themselves.

The film was produced in the educational laboratory of the University of Chicago and the photographs were made by one of the writers, who is not a trained photographer. The film, therefore, is somewhat lacking from the aesthetic point of view. It is adequate, however, from the point of view of clearness in the presentation of aspects of position which it was designed to show.

For the illustration of the good and poor positions of the body, head, and arms, a subject—a girl of ten years of age—was posed. This was an entirely satisfactory procedure since these positions can very readily be assumed voluntarily. A particular position of the body, head, or arms is not so fundamental and fixed a feature of one's habitual behavior as is the manner of holding the pen or of moving the hand. Accordingly the positions of the hand were not posed. To illustrate these aspects of position children were selected to be photographed whose habitual manner of writing exemplified the various types.

The content of the film may best be indicated by a list of the subtitles.

THE SUBTITLES OF THE HANDWRITING FILM

1. *Good and Poor Positions in Handwriting*
2. *Good Position: Facing desk squarely, body erect*
3. *Bad Position: Body slumped*
4. *Good Position: Head upright*
5. *Bad Position: Head turned and bent*
6. *Good Position: Both arms on desk alike*
7. *Bad Position: Only one arm on desk*
8. *Good Position: Right forearm at right angle to line of writing*
9. *Bad Position: Forearm not at right angle to line*
10. *Good Position: Hand and wrist nearly level*
11. *Bad Position: Hand turned over on side*
12. *Good Position: Hand resting on nails or last joint of fingers*
13. *Bad Position: Hand resting on side or base of hand*

14. *Good Position: Finger on penholder below thumb*
15. *Bad Position: Finger opposite or above thumb*
16. *Good Position: Easy grasp of penholder*
17. *Bad Position: Tight grasp*
18. *Good Movement: Smooth, easy side movement*
19. *Fair Movement: Side movement at wrist*
20. *Bad Movement: Hand hitches and jerks across the page*

EXPERIMENT 1

THE EVANSTON EXPERIMENT

The experiment in Evanston was made during the summer session of 1922. Forty-eight pupils, in two rooms, from Grades V-VIII, were selected for the experiment. These pupils were first tested with the score card and divided into two matched groups. Each pupil of one group was paired as closely as possible in the score in position with a pupil in the other group. The average score of the experimental group was 24.9 and of the control group 25. In each room there was a control group and an experimental group.

The instruction lasted for three weeks. Both groups of pupils had the same instruction, except that on three days the experimental group viewed the film in place of their usual penmanship drill. The pupils of the two groups were together for the writing instruction and were taught by the same person, the writing supervisor. The pupils of the two groups were from the same school grades and the groups had approximately an equal proportion of boys and girls. In both groups position was emphasized in the following ways: the teacher illustrated proper positions, corrected improper positions, commented on the pupils whose position was good, gave each pupil his score in detail and called his attention to his deficiencies, and, finally, required pupils to score each other. Thus position was emphasized in the instruction of all the children and the only difference between them was that one group saw the film three times.

The results in terms of average gain are indicated in Table II.

A comparison was also made by pairing children in the two groups who had an equal initial score and an equal amount of

instruction. Eighteen such pairs were found. Out of the eighteen pairs the child in the film group made the greater gain in eleven cases, the child in the control group in five cases, and in two cases they were tied.

It goes without saying that if this were the only experiment which had been made with the film the number of cases would be too small to form the basis of any but very tentative conclusions. The results of the experiment indicate decidedly, so far as they go, that the film is an effective instrument of instruction,

TABLE II
THE GAINS MADE BY THE FILM GROUP AND
THE CONTROL GROUP IN THE
EVANSTON EXPERIMENT

	Film Group	Control Group
Average number of lessons....	11.80	12.30
Average initial score.....	24.90	25.00
Average final score.....	27.80	26.80
Average gain.....	2.90	1.80
Percentage of possible gain...	.41	.26

but we shall have to defer decision until the results of the more extensive experiment in Detroit have been reviewed.

THE DETROIT EXPERIMENT

The experiment in Detroit was carried out on a large scale. Nearly 1,500 children took part in it. Each of these children was graded by means of the score card in position before and after the period of special instruction. Each child was also graded in quality of writing at the beginning and end of the experiment. Fifteen schools and twenty teachers took part in the experiment. The children were drawn from two grades, Grades IV A and VI A. Classes were selected whose teachers were rated as nearly as possible alike by the supervisor in handwriting.

In order to insure comparable results from the use of the score card by the three supervisors, a preliminary experiment was

made in which all of the supervisors scored the same pupils. After the pupils were scored the results were compared and the discrepancies in the scores were discussed. The process was then repeated and this training was continued until the three testers agreed in their standards of scoring. The scoring in quality of handwriting was all done by one person.

Instead of two types of instruction, as in the Evanston experiment, three types of instruction were compared in Detroit. Each type of instruction was given to a group of grades. The statistics concerning the grades and the number of children who were given the three forms of instruction are presented in Table III. To Group 1 the handwriting film was shown three times. Aside from this, the instruction in position was the routine type of instruction which is ordinarily given in the system. To the pupils of Group 2 the results of their ratings upon the score card was reported, as well as the rate and quality of their writing as indicated by the test. They were also given an opportunity to compare their individual scores with the medians of their group and with the medians of the other groups. The pupils of Group 3 were given simply the ordinary instruction. The instruction continued for a period of four weeks.

The results of the experiments are expressed by two types of tabulation. The first tabulation consists of the distribution of the score points made by the different groups. In the second form of tabulation each item of position is presented separately. Tabulations of total scores are presented in Table IV. The upper half of the table represents the results in the IV A classes and the lower half in the VI A classes. In each table the distribution of scores of each group is given in the preliminary test and in the final test. For example, in the IV A classes in Group 1, ten pupils made a score of 24 points in the preliminary test, thirty-nine pupils a score of 21 points and so on. The median of scores of Group 1 in the preliminary test was 19.1 points. In the same way the entire table may be interpreted.

In addition to the tabulation of the medians the gains have been calculated and are shown at the bottom of each half of the

table. Thus Group 1 made a gain of 3.1 points during the instruction, Group 2 a gain of 1.3 points, and Group 3 a gain of 1.8 points. The gain of the entire group of IV A classes was 1.9 points. In the case of the VI A classes the gain of Group 1 was 2.1 points, of Group 2, .7 points, of Group 3, .4 points, and of the entire group 1.2 points.

TABLE III

	SCHOOL	TEACHER	GRADE		RATING
			IV A	VI A	
Group 1.....	Balch	Truesdell	66	.....	B+
	Balch	Marlin	.....	72	B+
	Greusel	Horgan	60	41	B+
	A. L. Holmes	Leach	44	60	B+
	Lincoln	Mroch	81	.....	B
	Lincoln	McNeil	.....	48	B+
Total.....	.....	.....	251	221	.....
Group 2.....	Pattengill	Huston	52	.....	B+
		Halpen	.....	69	B+
	Stephens	Twohy	58	.....	B
		Barclay	.....	39	B
	Thirkdell	Moll	56	41	B
	Bishop	Wisser	96	.....	B
	Bishop	Paient	.....	61	B+
Total.....	.....	.....	262	210	.....
Group 3.....	Longfellow	Cummins	72	.....	B
		Crane	.....	69	B
	Moore	Lovett	46	.....	B
		Leonard	.....	78	B+
	Russell	Kunze	94	.....	B+
		Cobel	.....	45	B+
	Marxhausen	Calcaterra	61	63	B
Total.....	.....	.....	273	255	.....

The percentage of possible gain was calculated by finding the difference between the median initial score and the perfect score and then finding the percentage which the gain was of this difference. It will be seen that the percentage gain in the case of the IV A classes was .39 in the case of Group 1, .20 in the case of Group 2, .27 in the case of Group 3; while in the case

of the VI A classes the percentage gain was for Group 1, .38, Group 2, .15, and Group 3, .09. The similarity of the percentage gain of Group 1 in the Detroit experiment and in the Evanston experiment is striking. In every case the superiority in the

TABLE IV
TOTAL SCORES IN POSITION OF THE THREE GROUPS BEFORE AND AFTER
THE PERIOD OF EXPERIMENT

SCORE	PRELIMINARY				FINAL			
	Group 1	Group 2	Group 3	Total	Group 1	Group 2	Group 3	Total
IV A Classes								
27.....	.....	4	1	5	1	4	1	6
24.....	10	27	27	64	33	40	57	130
21.....	39	67	68	174	87	91	91	269
18.....	65	70	72	207	45	64	58	167
15.....	42	42	47	131	5	19	16	40
12.....	14	9	9	32	1	1	1	3
9.....	2	.....	.....	2	.....	.....	.....	.....
6.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	172	219	224	615	172	219	224	615
Median.....	19.1	20.5	20.3	20.1	22.2	21.8	22.1	22.0
Gain.....	.....	.....	.....	.....	3.1	1.3	1.8	1.9
Percentage of possible gain.....	.....	.....	.....	.....	.39	.20	.27	.275
VIA Classes								
27.....	1	3	7	11	4	4	6	14
24.....	23	35	61	119	56	49	66	171
21.....	52	72	67	191	60	74	87	221
18.....	36	31	38	105	15	24	30	69
15.....	22	10	16	48	3	4	2	9
12.....	4	4	2	10	.....	.....	.....	.....
9.....	.....	.....	.....	.....	.....	.....	.....	.....
6.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	138	155	191	484	138	155	191	484
Median.....	21.4	22.3	22.7	22.1	23.5	23.0	23.1	23.3
Gain.....	.....	.....	.....	.....	2.1	.7	.4	1.2
Percentage of possible gain.....	.....	.....	.....	.....	.38	.15	.09	.245

case of Group 1 over Groups 2 and 3 is marked, but more marked in the case of the VI A than of the IV A classes.

It will be noticed that the median score of Group 1 in case of both the IV A and the VI A classes is lower than the median of

either Group 2 or Group 3. It was expected that the wide selection of classes would give about the same median scores for the three groups and it is unfortunate that this equality does not obtain. We must, therefore, face the question whether the greater gain of Group 1, which received the instruction by motion pictures, can be ascribed to their lower initial score.

It is possible that some part of the superiority of the gain of Group 1 may be ascribed to this difference in their initial score. It is to be noted, however, that the calculation of the percentage of possible gain, to some degree at least, balances this difficulty in initial score. If all the groups could be thought to have attained their maximum score by the end of the experiment, then, of course, the objection would be a serious one. That this is not the case is indicated by the distribution of the scores and also by the comparison of the gains and the final scores of the IV A and the VI A classes. The VI A classes made a score which was 2 points higher than the IV A classes in the initial test, and 1.3 points in the final test. The gain of the IV A classes was therefore greater than that of the VI A classes, but the percentage gain is nearly the same. This seems to indicate that the calculation of the percentage gain, to a large degree at least, counterbalances the differences which occur in the preliminary standing. Further evidence that the superiority in the gain of Group 1 was not due to its lower initial score is given at the end of the chapter.

We may then conclude that so far as the total score is concerned the group which was shown the film made markedly greater gains than the other two groups.

The comparative gain of Groups 2 and 3 is rather puzzling. In the IV A classes, Group 3, which consisted of children who were not informed of their scores but were given rather incidental instruction in position, made a slightly greater gain than did Group 2. In the VI A classes, Group 2 made a greater gain than Group 3, as we should expect. Since the differences between Groups 2 and 3 are not large, and are in opposite directions in the two grades, it seems necessary to conclude that it is not particularly effective to show the pupils their scores in

handwriting position. If this is the case the explanation may be that in this case the pupils did not understand clearly the meaning of their scores. The handwriting film showed in objective form the difference between good and poor position. It appears that this was helpful. When, however, the pupils were given their scores, in terms of the verbal description of the various types of position, the scores seemed to lack effectiveness because the children were not able to translate these verbal descriptions into concrete terms. We may conclude that the failure of the children in Group 2 to profit by a knowledge of their scores was due to their inability to translate these scores into concrete terms. Possibly the superior effectiveness of this method in the VI A classes was due to their greater maturity and their superior ability to interpret their scores. We may perhaps venture the general conclusion that the value of revealing to pupils their scores in attainment is dependent upon their ability to understand clearly the meaning of their scores in terms of achievement.

The changes in the scores of the pupils in each particular item of position are shown in Tables V, VI, and VII, and in Figures 2-7. In Table V the scores of Group 1 are given, and in Tables VI and VII the scores of Groups 2 and 3. In each group the scores of the fourth grade and the sixth grade are given separately. The tables show the number and percentage of pupils of each of the groups which received the various scores before the training and after the training, and then shows the differences in the percentages who received the various scores. For example, in the case of Grade IV A of Group 1 the following are the scores in body position: In the preliminary test 124 pupils were scored 3; 34 were scored 2; and 14 were scored 1. In terms of percentage 72 per cent received a score of 3; 20 per cent received a score of 2, and 8 per cent a score of 1. After the period of instruction 91 per cent of these pupils received a score of 3; 8 per cent a score of 2; and 1 per cent a score of 1. This makes an increase of 19 per cent of pupils who received a score of 3, and a decrease of 12 per cent in those who received a score of 2, and 7 per cent

who received a score of 1. This, of course, means a gain in efficiency, since a larger percentage of pupils received the high scores and a smaller percentage the low scores.

TABLE V

THE DISTRIBUTION OF THE SCORES IN POSITION OF GROUP 1 IN THE PRELIMINARY AND FINAL TESTS, AND THE INCREASE OR DECREASE IN THE PERCENTAGE OF PUPILS WHO RECEIVED THE VARIOUS SCORES

POSITION	GRADE IV A					GRADE VI A				
	Pre-liminary	Per-cent-age	Final	Per-cent-age	Difference Cols. 2 and 4	Pre-liminary	Per-cent-age	Final	Per-cent-age	Difference Cols. 7 and 9
Body:										
Facing desk.....	124	72	157	91	19	100	72	129	94	22
Turned slightly.....	34	20	14	8	-12	33	24	7	5	-19
Turned to side.....	14	8	1	1	-7	5	4	2	1	-3
Body:										
Erect.....	66	38	154	90	52	71	51	123	89	38
Fairly erect.....	88	51	18	10	-41	60	44	14	10	-34
Slumped.....	18	11	0	0	-11	7	5	1	1	-4
Head:										
Upright.....	52	30	132	77	47	36	26	100	72	46
Turned slightly.....	72	42	34	20	-22	79	57	29	21	-36
Turned much.....	48	28	6	3	-25	23	17	9	7	-10
Arms:										
Both on desk.....	130	76	161	94	18	113	82	133	96	14
One on desk.....	42	24	11	6	-18	25	18	5	4	-14
Arms:										
Symmetrical.....	92	53	138	80	27	87	63	122	88	25
Unsymmetrical.....	80	47	34	20	-27	51	37	16	12	-25
Arms:										
Square with.....	94	55	124	72	17	97	70	113	82	12
Not square.....	78	45	48	28	-17	41	30	25	18	-12
Hand:										
Nearly level.....	34	20	44	26	6	44	32	57	41	9
Turned slightly.....	83	48	99	57	9	72	52	70	51	-1
Turned far.....	55	32	29	17	-15	22	16	11	8	-8
Hand:										
On fingers.....	16	9	20	12	3	21	15	28	20	5
Partly on joint.....	71	41	80	46	5	74	54	77	56	2
On hand.....	85	50	72	42	-8	43	31	33	24	-7
Hand:										
Finger below.....	50	29	47	27	-2	39	28	41	30	2
Finger opposite.....	91	53	105	61	8	90	65	90	65	0
Finger above.....	31	18	20	12	-6	9	7	7	5	-2
Hand:										
Loose grasp.....	12	7	24	14	7	41	30	48	35	5
Moderate grasp.....	47	27	83	48	21	54	39	66	48	9
Tight grasp.....	113	66	65	38	-28	43	31	24	17	-14
P medians.....	19	.....	22	.....	.....	21	.....	24	.....	.....
R medians.....	72	.....	79	.....	.....	83	.....	89	.....	.....
Q medians.....	43	.....	44	.....	.....	57	.....	58	.....	.....
Number of pupils.....	172	.....	172	.....	.....	138	.....	138	.....	.....

P means the median position score for the group on position test.
 R means the median rate score for the group on writing test.
 Q means the median quality score for the group on writing test.

The increases or decreases in percentage of pupils receiving the various scores are shown graphically in the figures. A large gain in achievement is indicated, of course, by a large increase

of the high scores and a large decrease in the low scores. We may now turn to the figures for a comparison of the gains made by the various groups of pupils.

TABLE VI

THE DISTRIBUTION OF THE SCORES IN POSITION OF GROUP 2 IN THE PRELIMINARY AND FINAL TESTS, AND THE INCREASE OR DECREASE IN THE PERCENTAGE OF PUPILS WHO RECEIVED THE VARIOUS SCORES

POSITION	GRADE IV A					GRADE VI A				
	Pre-liminary	Per-cent-age	Final	Per-cent-age	Difference Cols. 2 and 4	Pre-liminary	Per-cent-age	Final	Per-cent-age	Difference Cols. 7 and 9
Body:										
Facing desk.....	154	70	201	91	21	122	79	147	94	15
Turned slightly.....	47	22	13	6	-16	24	16	7	5	-11
Turned to side.....	18	8	5	3	-5	9	5	1	1	-4
Body:										
Erect.....	96	44	182	83	39	89	57	143	92	35
Fairly erect.....	105	48	34	16	-32	57	37	12	8	-29
Slumped.....	18	8	3	1	-7	9	6	0	0	-6
Head:										
Upright.....	52	24	124	57	33	49	32	91	58	26
Turned slightly.....	107	49	75	34	-15	80	52	58	37	-15
Turned much.....	60	27	20	9	-18	26	16	6	5	-11
Arms:										
Both on desk.....	171	79	197	90	11	143	92	154	99	7
One on desk.....	48	21	22	10	-11	12	8	1	1	-7
Arms:										
Symmetrical.....	129	41	171	78	37	114	74	147	95	21
Unsymmetrical.....	90	59	48	22	-37	41	26	8	5	-21
Arms:										
Square with.....	147	67	166	76	9	114	74	131	85	11
Not square.....	72	33	53	24	-9	41	26	24	15	-11
Hand:										
Nearly level.....	96	44	89	41	-3	69	45	63	41	-4
Turned slightly.....	88	40	83	38	-2	74	48	59	38	-10
Turned far.....	35	16	47	21	5	12	7	33	21	14
Hand:										
On fingers.....	41	18	33	15	-3	40	26	28	18	-8
Partly on joint.....	80	41	78	36	-5	81	52	65	42	-10
On hand.....	89	41	108	49	8	34	22	62	40	18
Hand:										
Finger below.....	47	21	55	25	4	47	30	60	39	9
Finger opposite.....	146	67	145	66	-1	93	60	90	58	-2
Finger above.....	26	12	19	9	-3	15	10	5	3	-7
Hand:										
Loose grasp.....	55	25	29	13	-12	62	40	47	30	-10
Moderate grasp.....	90	41	74	34	-7	58	37	70	45	8
Tight grasp.....	74	34	116	53	19	35	23	38	25	2
P medians.....	21	.....	22	.....	.....	22	.....	23	.....	.....
R medians.....	70	.....	73	.....	.....	75	.....	80	.....	.....
Q medians.....	47	.....	50	.....	.....	64	.....	66	.....	.....
Number of pupils.....	219	.....	219	.....	.....	155	.....	155	.....	.....

P means the median position score for the group on position test.

R means the median rate score for the group on writing test.

Q means the median quality score for the group on writing test.

We may first examine the figures which give the results of the instructions of the three groups in the IV A classes with reference to each item of position, Figures 2, 4, and 6. In the

case of the first item of body position, the direction in which the body faces, there was about equal improvement in the case of Group 1 and Group 2. Group 3 excels slightly Group 1. Group

TABLE VII

THE DISTRIBUTION OF THE SCORES IN POSITION OF GROUP 3 IN THE PRELIMINARY AND FINAL TESTS, AND THE INCREASE OR DECREASE IN THE PERCENTAGE OF PUPILS WHO RECEIVED THE VARIOUS SCORES

POSITION	GRADE IV A					GRADE VI A				
	Pre-limi-nary	Per-cent-age	Final	Per-cent-age	Differ-ence Cols. 2 and 4	Pre-limi-nary	Per-cent-age	Final	Per-cent-age	Differ-ence Cols. 7 and 9
Body:										
Facing desk.....	151	67	204	90	23	153	80	168	88	8
Turned slightly.....	60	27	18	9	-18	30	16	23	12	-4
Turned to side.....	13	6	2	1	-5	8	4	.....	.....	-4
Body:										
Erect.....	96	43	158	71	28	115	60	154	80	20
Fairly erect.....	101	45	63	28	-17	65	34	34	18	-16
Slumped.....	27	12	3	-1	-11	11	6	3	2	-4
Head:										
Upright.....	74	33	110	49	16	80	42	108	56	14
Turned slightly.....	85	38	85	38	0	80	42	66	35	-7
Turned much.....	65	29	29	13	-16	31	16	17	9	-7
Arms:										
Both on desk.....	198	88	212	95	7	183	96	188	98	2
One on desk.....	26	12	12	5	-7	8	4	3	2	-2
Arms:										
Symmetrical.....	120	53	177	79	26	149	78	167	87	9
Unsymmetrical.....	104	47	47	21	-26	42	22	24	13	-9
Arms:										
Square with.....	127	57	165	74	17	137	72	151	79	7
Not square.....	97	43	59	26	-17	54	28	40	21	-7
Hand:										
Nearly level.....	76	34	87	39	5	76	40	80	42	2
Turned slightly.....	101	45	95	42	-3	80	42	89	47	5
Turned far.....	47	21	42	19	-2	35	18	22	11	-7
Hand:										
On fingers.....	40	18	49	21	3	64	33	57	30	-3
Partly on fingers.....	98	44	102	46	2	79	42	93	49	7
On hand.....	86	38	73	33	-5	48	25	41	21	-4
Hand:										
Finger below.....	57	25	50	22	-3	76	40	57	30	-10
Finger opposite.....	143	64	167	75	11	103	54	25	65	11
Finger above.....	24	11	7	3	-8	12	6	9	5	-1
Hand:										
Loose grasp.....	46	21	45	20	-1	91	48	74	39	-9
Moderate grasp.....	81	36	93	42	6	62	32	90	47	15
Tight grasp.....	97	43	86	38	-5	38	20	27	14	-6
P medians.....	20	.....	22	.....	.....	23	.....	23	.....	.....
R medians.....	66	.....	71	.....	.....	87	.....	87	.....	.....
Q medians.....	47	.....	49	.....	.....	58	.....	59	.....	.....

P means the median position score for the group on position test.

R means the median rate score for the group on writing test.

Q means the median quality score for the group on writing test.

3 made the greatest gain. In the case of the second form of body position, the erectness of the body, Group 1 excels both of the other groups noticeably. Group 2 excels Group 3. The

same thing is true of head position. Group 1 made the greatest gain and Group 3 the least. With reference to the first item in the position of the arms, Group 1 made the greatest gain and Group 3 the least. In the second item, the symmetrical position of the arms, Group 2 made the greatest gain and Groups 1 and

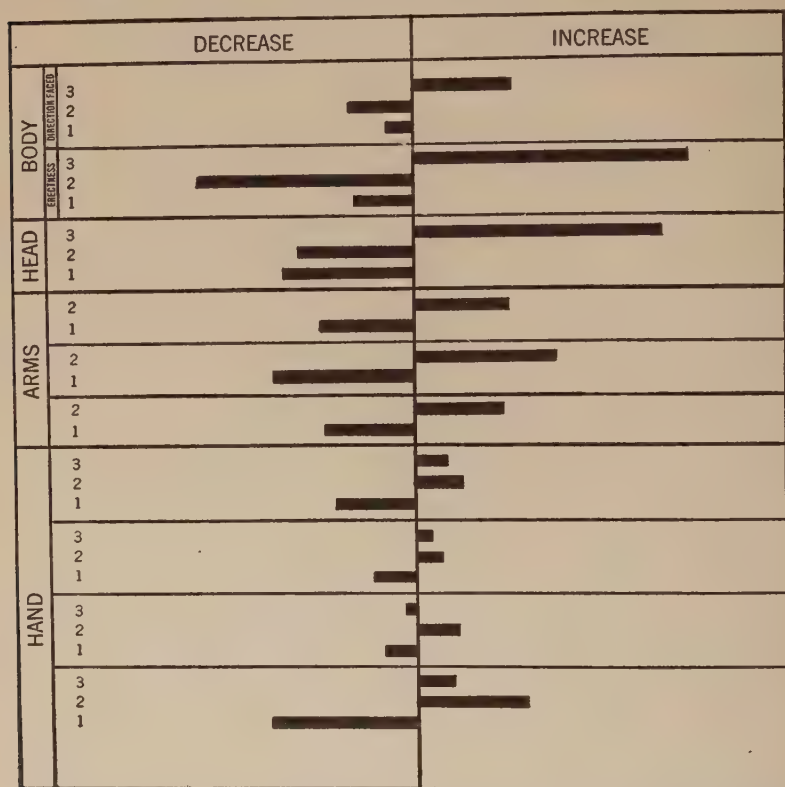


FIG. 2.—The increase or decrease in the percentage of pupils who were given the various scores on the individual aspects of position. Grade IV A, Group 1.

3 about the same gain. With reference to the third item, the position of the arms with reference to the line of writing, Groups 1 and 3 made about the same gain and Group 2 made the lowest gain. In the case of arm position in general, then, Groups 1 and 2 are about equal and are slightly superior to Group 3.

With reference to the first item of hand position, the degree of levelness of the hand, Group 1 made the greatest gain, and Group 3 made the second largest amount of gain; Group 2 appears actually to have lost in this respect. In the second item of hand position, the manner in which the hand is supported,

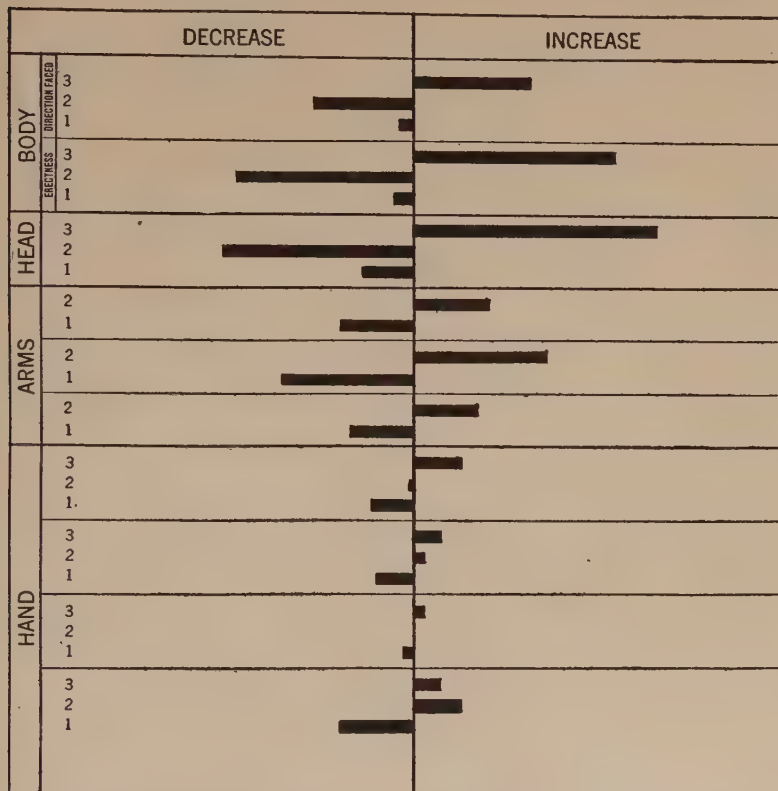


FIG. 3.—The increase or decrease in the percentage of pupils who were given the various scores on the individual aspects of position. Grade VI A, Group 1.

Group 2 again lost while Groups 1 and 3 appear to have made slight gains. In the third item, the relative position of the finger and the thumb on the penholder, each group made slight gains. In the last item, looseness of grasp, Group 1 made a large gain, Group 3 a very slight gain, and Group 2 lost. In summary,

it appears that Group 1 made the greatest gain in six items, Group 2 in one item, and Group 3 in one. Group 2 lost in three items.

We may now examine the charts which exhibit the results in the VI A classes. In the first item of head position, Group 1

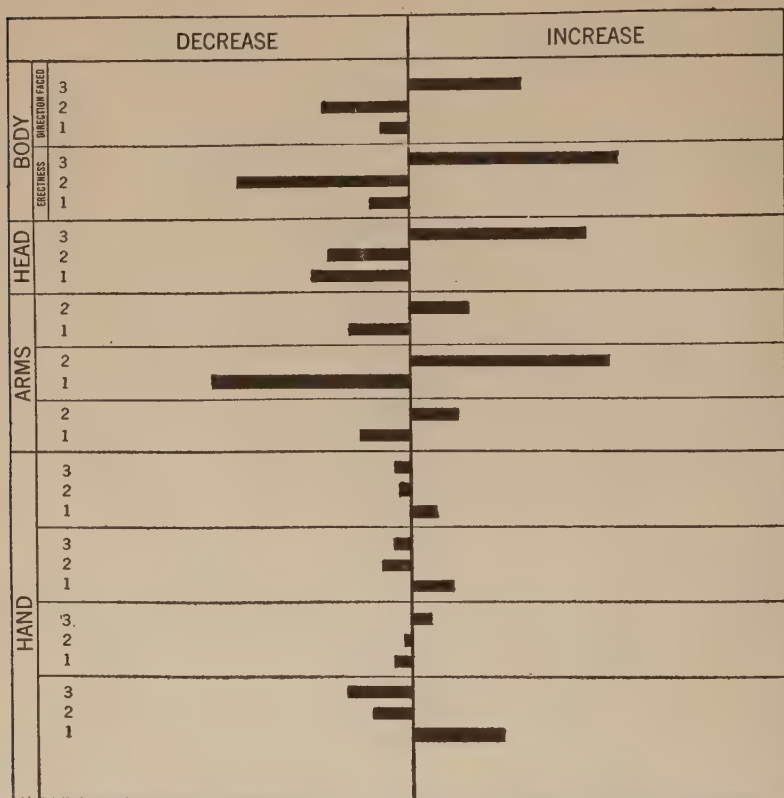


FIG. 4.—The increase or decrease in the percentage of pupils who were given the various scores on the individual aspects of position. Grade IV A, Group 2.

made the greatest gain and Group 3 the least. In the second item of body position Group 1 made slightly the greatest gain and Group 3 decidedly the least. In the third item, head position, Group 1 made decidedly the greatest gain and Group 3 the least. In arm position Group 1 made the greatest gain in

each item and Group 3 the least, although the difference between Group 1 and Group 2 is slight in the second and third items. In hand position Group 1 made the greatest gain in all types of position except the third, in which it was excelled by Group 2. Group 2 was excelled by Group 3 in the first and second type of

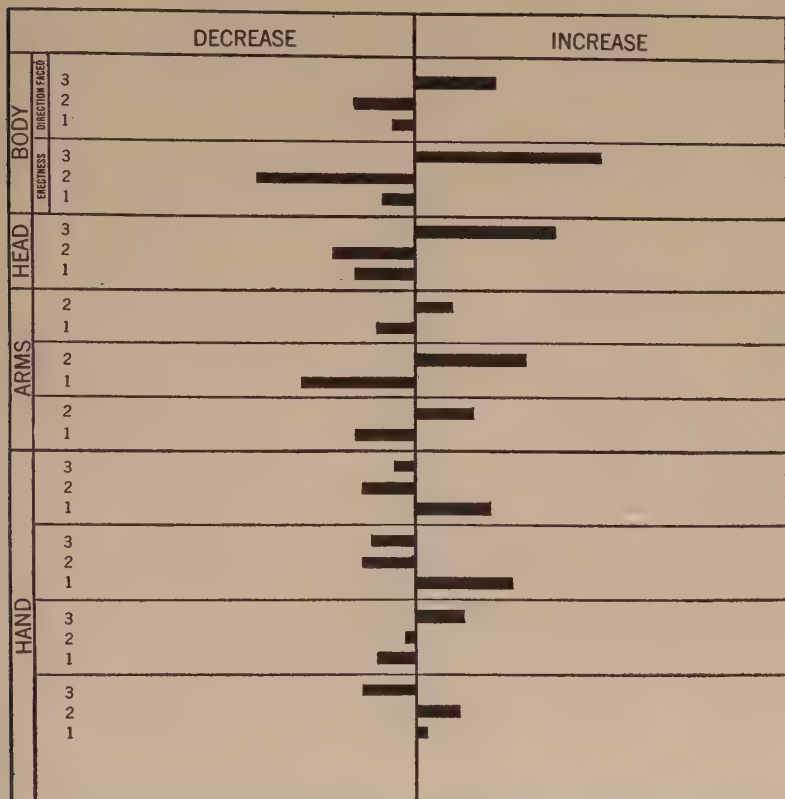


FIG. 5.—The increase or decrease in the percentage of pupils who were given the various scores on the individual aspects of position. Grade VI A, Group 2.

hand position. In the third and fourth types Group 2 excelled Group 3. In the VI A classes, then, there is only one type of position in which the greatest gain in scores was made by any other than Group 1. This is true of the third type of hand position, in which Group 3 excelled.

A comparison of the gains in both grades indicates that Group 1 was markedly superior in both grades in respect to head position and the first type of arm position. This may perhaps indicate that the film is particularly effective in showing

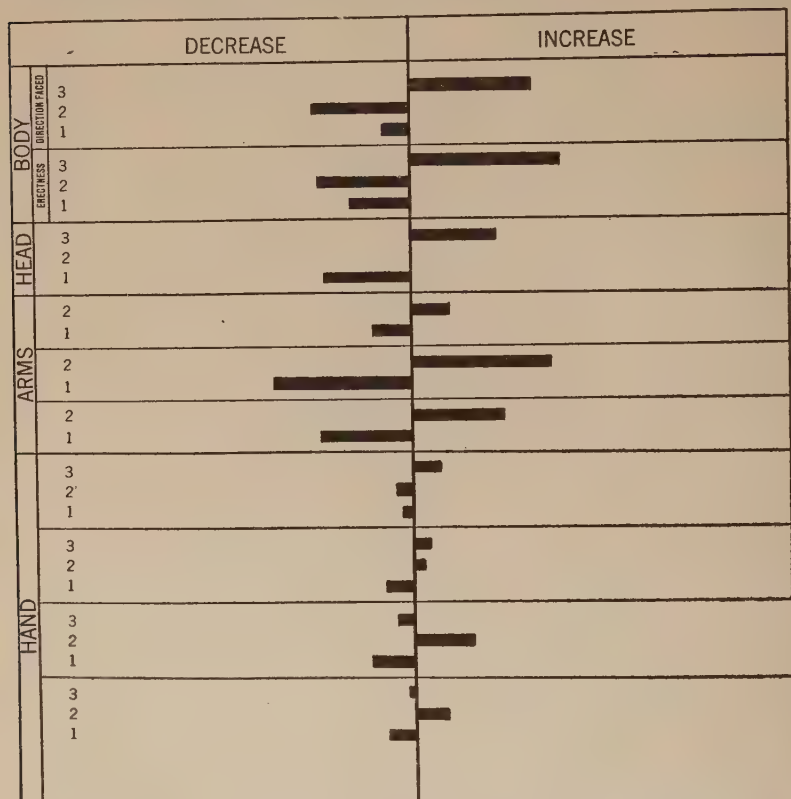


FIG. 6.—The increase or decrease in the percentage of pupils who were given the various scores on the individual aspects of position. Grade IV A, Group 3.

these two types of position. Otherwise no one item stands out as consistently and markedly superior in both grades. We may then conclude that the film is the most effective method of those that are in general use and that in the case of these two items it seems to have especial effectiveness.

It will be remembered that a question arose in the interpretation of the gains made by Groups 1, 2, and 3 in the total scores from the fact that Group 1 had a lower score before the experiment than did the other two groups. Some light may be

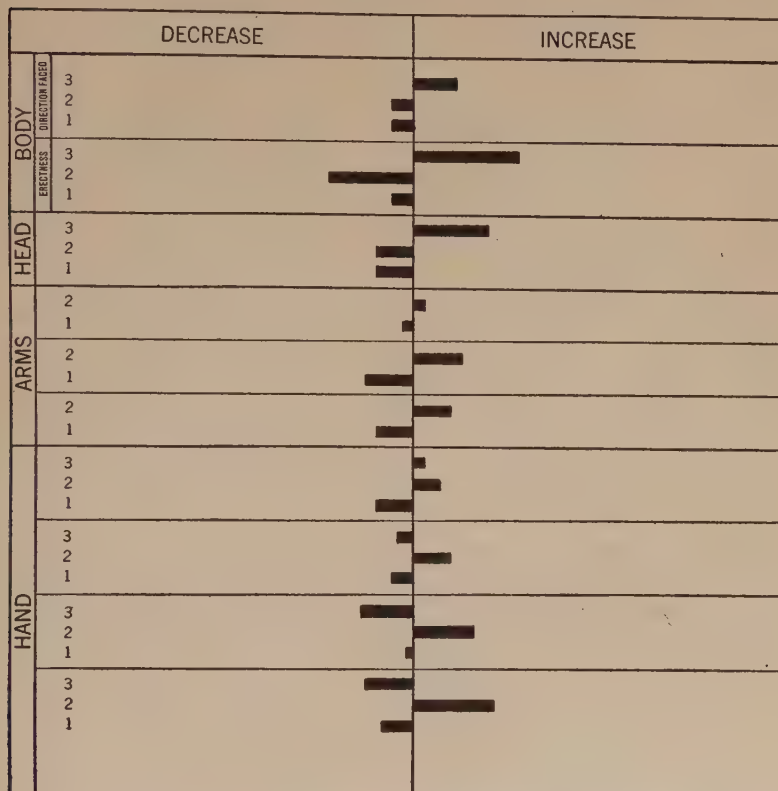


FIG. 7.—The increase or decrease in the percentage of pupils who were given the various scores on the individual aspects of position. Grade VI A, Group 3.

thrown upon the meaning of this situation by a study of the scores in quality and the gains in quality made during the experiment. The distribution of these scores is given in Table VIII. It will be seen from an inspection of the medians that Group 1 was inferior in quality to Groups 2 and 3 in both the fourth- and

the sixth-grade classes. In spite of this fact Groups 2 and 3 made on the whole greater gains than did Group 1. This is decidedly true in the IV A classes, and in the VI A classes the

TABLE VIII

DISTRIBUTION OF THE SCORES IN QUALITY OF WRITING AT THE
BEGINNING AND END OF THE EXPERIMENT

SCORE IN QUALITY	PRELIMINARY				FINAL			
	Group I	Group II	Group III	Total	Group I	Group II	Group III	Total
IVA Classes								
95-100.....								
85-94.....								
75-84.....						2	1	3
65-74.....	5	17	17	39	4	21	17	42
55-64.....	21	34	37	92	25	45	44	114
45-54.....	44	74	75	193	49	81	78	208
35-44.....	77	76	74	227	65	54	69	188
25-34.....	24	18	20	62	28	16	15	59
15-24.....	1		1	2	1			1
0-14.....								
Total.....	172	219	224	615	172	219	224	615
Median.....	42.9	47	47.2	45.8	43.7	49.8	48.5	47.8
Gain.....					.8	2.8	1.3	2.0
VIA Classes								
95-100.....								
85-94.....		7		7		7		7
75-84.....	2	16	5	23	1	16	4	21
65-74.....	26	52	48	126	39	58	49	146
55-64.....	51	28	61	140	42	41	69	152
45-54.....	43	36	53	132	44	21	46	111
35-44.....	16	16	23	55	10	12	22	44
25-34.....			1	1	2		1	3
15-24.....								
0-14.....								
Total.....	138	155	191	484	138	155	191	484
Median.....	56.9	64	58	58.8	58	65.6	58.8	60.5
Gain.....					1.1	1.6	.8	1.7

gain of Group 1 is about equal to the average of the gains of Groups 2 and 3. It will thus be seen that a lower score at the beginning of the experiment did not, in the case of quality, effect a greater gain. We may, therefore, infer that the lower score in

position did not account for the greater gain of Group 1 over the other two groups. Furthermore, we may infer that the fact that Group 1 made the greatest gain was not due to a general superiority in instruction. If this had been the case it would also have made the greatest gain in quality.

CONCLUSION

The experiments in Evanston and Detroit agree in the fact that the pupils who were shown the film made markedly greater gains in position than did the groups who received other types of instruction. Every type of criticism to which we may subject the data and every form of analysis to which it may be subjected leads to the same conclusion. It appears to be reasonably well established, therefore, that the film is particularly effective as a mode of instruction.

Whether the superior effectiveness of a film is due to the fact that it gives the pupils a clearer notion of what correct position is and how it is contrasted with poor position, or whether the effectiveness is due to the fact that it causes the pupils to admire good position or to desire to adopt it themselves, the facts of the experiment do not indicate. We may perhaps suppose that it was effective on both grounds.

The fact that the sixth-grade pupils profited from a knowledge of their scores, while the fourth-grade pupils did not, suggests that the value of giving pupils their scores may be limited by their ability to understand the meaning of the scores.

CHAPTER VIII

COMPARISON OF MOTION PICTURES, SLIDES, STEREOGRAPHS, AND DEMONSTRATION AS A MEANS OF TEACHING HOW TO MAKE A REED MAT AND A PASTEBOARD BOX

F. D. McCLUSKY AND H. Y. McCLUSKY

It is well-nigh impossible to control the complexity of elements in an educational experiment. Hence the critical experimenter must constantly strive to reduce this intricacy to a point where more perfect control of all factors can be obtained. This restriction of the problem has one limitation. The results of the experiment will have a correspondingly narrow application. This situation appears in the experiments which are described in the following paragraphs.

The plan of this group of experiments was to prepare all the items of the investigation expressly for the experimental situation. For example, while in former experiments we were limited to the task of organizing an experiment around a film already in existence, in this instance the films were produced for the experiment. This made possible the arrangement of the subject-matter in a manner more effective for teaching. Likewise other items were included in the outline of the procedure which enabled us to control more elements of the problem than had been possible in our previous experiments.

These items can be briefly enumerated:

1. We sought a simple instructional unit in which motion was a fundamental part of the concept. Thus we could compare the effectiveness of the motion picture and the still picture in teaching such an activity.
2. We sought a unit for teaching purposes whose product could be tested in terms other than language.

3. We sought a unit of instruction which could be easily administered, definitely taught and which would produce results which could be quickly and objectively measured.

The task of finding units of instruction which would meet all these requirements was a difficult one. Many suggestions were tried and found wanting. Promising ideas led into the blind alley of prohibitive cost, others resulted in products which were not easily and objectively measurable. In the end the field narrowed to two subjects, "How to Make a Reed Mat" and "How to Make a Pasteboard Box."

The selection of these two instructional units made it possible to construct tests which consisted of having the subjects repeat the activity taught. That is, they were shown how to make a pasteboard box and then were asked to make a box with the same materials used in the demonstration. Thus the test was a measure of the ability of pupils to repeat, with the same materials, under similar conditions, the activity demonstrated during the instructional period.

The motion picture films used as a basis of the instructional units "How to Make a Pasteboard Box," and "How to Make a Reed Mat," were produced in the photographic laboratory of the University of Illinois. A committee of three worked together to turn out the best possible teaching films. Mr. A. G. Eldridge of the photographic laboratory, an expert photographer with long experience in producing educational films, furnished the photographic technique. The action in the films was supplied by an expert teacher of reed basketry and cardboard construction, Mr. A. B. Mays, associate professor of industrial education at the University of Illinois. The scenario for each film was written by the writer.

Slides and stereographs of these processes were made at the same time the film was produced. Thus the pictures used in the instruction of the various groups were identical, whether they were film, slide, or stereograph, and the only variable introduced into the instruction of the groups was the fact that an individual other than Professor Mays was the "demonstration instructor."

Further reliability of results was obtained by rotating the groups and by repeating the experiments on successive grade levels in the schools of two cities, namely, the Weber School, Urbana, Illinois, and the North Doan School in Cleveland, Ohio.

The experimental technique employed in all the experiments was the same. A description of the procedure for one experiment would suffice for any of the others. The difference between the experiments was in the comparisons made. For example, Experiments 1 and 2 at Urbana did not compare stereograph instruction with the other forms of instruction.

PROBLEM

The task of making a pasteboard box by folding tag board, and the task of weaving a reed mat, present constructive activities in which manual skill and the apprehension of movement are essential elements. The problem attacked was the determination of how accurately and quickly pupils could make a box or mat under the conditions set up. These conditions permitted comparisons of teaching with (1) the film, (2) the slide, (3) the stereograph, and (4) the demonstration (in which the object was actually made before the class). Cross-comparisons were also made between each of these forms of instruction.

DESCRIPTION OF THE EXPERIMENTS

I. SUBJECTS

Pupils of the fourth, fifth, and sixth grades of the Weber School, Urbana, Illinois, and the North Doan School, Cleveland, Ohio, acted as subjects in the experiments. The age of each pupil in years and months was obtained from the records in the principal's office. Groups were formed in each of the two schools on the basis of age and grade. The pupils in each grade were ranked in order of chronological age, and parallel groups were formed then by distributing pupils of the same age among the several groups. Pupils who could not be matched were thrown out of consideration. The age-grade basis of forming

equal groups was adopted, since the ability to do constructive work is not measured by existing intelligence or school tests.

2. TOPIC

The activities taught were "How to Make a Pasteboard Box" and "How to Make a Reed Mat."

3. PRESENTATION OF THE TOPIC

An unoccupied classroom at the Weber School in Urbana, and the gymnasium in the North Doan School in Cleveland, were used for the experiments. This insured that there would be no interruptions during the periods of instruction and testing.

Preliminary to each method of instruction each group was seated in a semi-circle before the demonstrator or screen. The following instructions were then read to each group:

This morning I am going to show you all how to make a $\left\{ \begin{array}{l} \text{pasteboard box.} \\ \text{reed mat.} \end{array} \right.$

Pay strict attention to all you see and hear so you will be able to make a $\left\{ \begin{array}{l} \text{box} \\ \text{mat} \end{array} \right.$

like the one I have here. These are useful in the home $\left\{ \begin{array}{l} \text{to place things in.} \\ \text{to put hot dishes on.} \end{array} \right.$

I want you all to make one as good as this one.

The instruction given each group may be briefly described as follows:

a) The demonstration consisted in having the instructor actually make a box or mat before the group. The instructor called the attention of the group to the steps in the process by comments given during the demonstration.

b) The slide instruction consisted in showing a series of slides illustrating each step in the process of making a pasteboard box or reed mat. The slides were accompanied by oral explanations, calling the attention of the group to each phase of the process.

c) The stereograph instruction was similar to the slide instruction in that each pupil looked at the same set of pictures as was shown by the slides. Each pupil had his own set of stereographs piled in order in front of him and on a signal all

looked at the same picture through a stereoscope. The instructor emphasized steps in the process by oral explanations as the group progressed through the set of stereographs.

d) The film instruction consisted in showing the film to the children in the one group. The American projector was used with a throw of 20-30 feet which insured good illumination. The instructor explained the steps in the process of making a pasteboard box or mat during the showing of the film. The instructor and class read all subtitles together orally.

The outline of the films by subtitles and scenes follow.

HOW TO MAKE A PASTEBOARD BOX

OUTLINE OF CONTENTS

(Subtitles italicized)

Materials: One piece of medium-weight tag board 12×12 inches, paste, scissors.

Steps in making a rectangular tray.

Paper and cardboard construction.

Fold bottom to top edge, crease and open flat.

The film shows this operation.

To make your fold straight across, crease with forefinger to center, then cut.

As above, the film shows this operation.

Fold bottom to center and open flat.

Fold bottom to second crease and open.

Turn paper around and fold top to center crease and open.

Fold top to top crease and open.

The paper looks like this.

The paper now has five creases: two broad strips in the center and two narrow ones on each side.

Take scissors and cut along the line of the second crease from the bottom.

This operation removes the strip which is not used in the finished box.

Fold bottom to old center and paper looks like this.

Next fold left to right edge, left to center, left to crease, and open.

Repeat the process for the other side.

The paper looks like this.

There are now four creases from side to side, and five from end to end.

Take scissors and cut in first crease to first crease.

Fold flaps in.

Glue flaps.

The glue must have time to dry.

The completed tray (box).

REED BASKETRY

OUTLINE OF CONTENTS

(Subtitles italicized)

The weaving of a mat contains all the fundamental steps in reed basketry.

First the reed is soaked in water until it can be easily bent.

Pieces of reed about 15 inches long and $\frac{1}{2}$ inch in diameter are used for spokes.

This is a spoke.

Four spokes are placed between the thumb and the forefinger of the left hand side by side.

Next three spokes are placed on top of the first four at right angles and held tightly.

Then half of a spoke is placed side by side with the first four to make an odd number of spokes.

Do not forget the extra half-length spoke.

One end of the weaver is picked up by the right hand and placed by the side of the three spokes so that the long part of the weaver hangs free to the left.

The weaver goes back around the up and down spokes.

Then over the cross-spokes.

And under the up and down spokes.

Then over the cross-spokes until four rounds are completed. This is called the "tie."

Weaving begins at this point. First the weaver goes back of or under the first up and down spoke to the left, then over the second spoke and under the third and over the fourth, and on and on until the mat reaches the desired size.

Soon the spokes spread apart until they look like a wheel.

The weaver must be kept firmly pressed down toward the center of the mat.

A splice is necessary when the first piece of weaver runs out. The second piece of weaver is placed along the first and the process of weaving is continued.

When the weaving is finished, the end is pushed into the space between the weaver at a spoke. This fastens the weaver.

The ends of the spokes are cut to equal length.

Each spoke is bent over and thrust between the weaver on the far side of the spoke to its left.

The finished mat.

4. THE TESTING CONDITIONS

Immediately following each instruction period the pupils were tested by having them make the pasteboard box or reed mat. The box test consisted in giving each pupil one sheet

of tag board $12'' \times 12''$, a pair of scissors, and a tube or dish of paste. Then they were instructed as follows:

Now I am going to ask you to make a box just like the one you have seen made. When I say "Go," begin to make your box. Raise your hand when you are through. Ready! Go!

The moment a pupil raised his hand, the length of time spent in making the box was noted and recorded by the examiners. When the last pupil had finished, the boxes were collected, piled together, and tagged with a label showing the date, form of instruction, and group.

The boxes were scored in terms of the accuracy with which they were made by making up a score card giving one point for each step correctly followed in the process of making the boxes. Each box was then graded on a basis of the score card. The score card is as follows:

SCORE CARD FOR PASTEBOARD BOX

	Points
1. Crosswise creases (one point each)	5
2. Lengthwise creases (one point each)	4
3. Length of flaps (one point for each flap)	4
4. Place of flaps (one point for each flap)	4
5. Fastening flaps inside end piece (1 point for each flap) . .	4
6. Amount of glue used in fastening flaps (1 point for each flap)	4
7. Strip cut off one side, two creases in from side	1
Total score, Urbana experiments	26
Total score, Cleveland experiments	22

(Paste instead of glue was used at Cleveland, hence item 6 was disregarded in the scoring)

EXPLANATION OF SCORE CARD

(Use diagram [Fig. 1] for reference)

1. If there are more than five cross-creases or less than five cross-creases, one point is subtracted from the total possible score for each addition or omission.
2. If there are more than four lengthwise creases or less than four lengthwise creases, one point is subtracted from the total possible score for each addition or omission.

3. If the flaps are cut more than one crease deep one point for each error is subtracted from the total possible score. Since there are four flaps there would be a possibility of four errors.
4. If the flaps are cut from the side, one point is subtracted from the total possible score for each error.
5. If the flaps are not turned *inside* the end strip and fastened there one point for each error is subtracted from the total possible score.

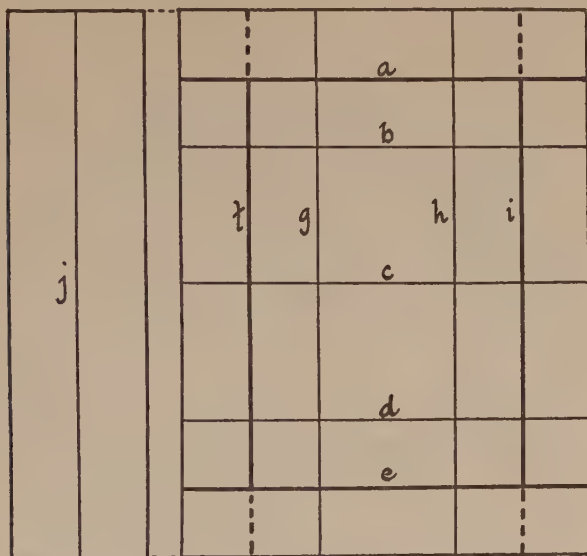


FIG. 1.—Diagram of box showing creases running lengthwise and crosswise. Cut flaps on dotted line and fold sides, ends and flaps on the heavy lines. *a, b, c, d, e* = five creases running crosswise; *f, g, h, i* = four creases running lengthwise; *j* = strip cut off, two creases in, to form oblong box.

6. If too much glue is used in fastening a flap one point is subtracted from the total possible score for each error. (NOTE.—In the Cleveland experiments a school paste was used for fastening which did away with the necessity of scoring the boxes on this point.)
7. If a strip is cut from both sides of the cardboard one point is deducted from the total possible score. If no strip is cut from any side one point is deducted.

The materials given each pupil for the mat test consisted of a pair of scissors or sloyd knife, one bundle of spokes, and a roll

of weaver. The spokes, eight in number, were of No. 4 reed, seven spokes 15 inches long, the one 8 inches long. The weaver in each roll was in two pieces of No. 2 reed. The total length of the two pieces was the same in each roll. Both the weaver and spokes were thoroughly soaked in water before they were used in the test period.

The pupils were seated around the room as far apart as possible and were supplied with materials for making the mat. Buckets of water were placed conveniently in the room so the pupils could dip their reed from time to time as the reed dried out.

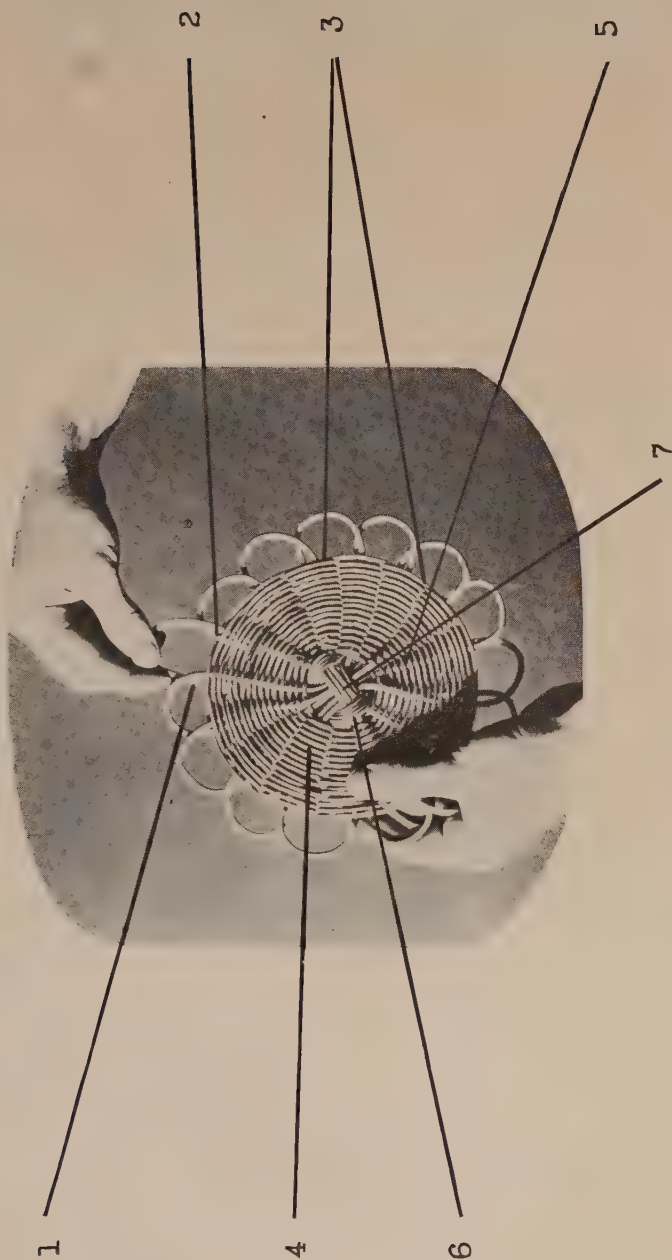
The pupils were instructed as follows:

Now I am going to ask you to make a mat just like the one you saw made. How many think they can make such a mat? [Show of hands.] You will all want to make a good mat, so follow directions carefully. Do not start making the mat till I say "Begin!" You have a roll of weaver and a bundle of spokes. Cut the string that ties them together and loosen the reed this way. [Demonstrate this.] See that you have two pieces of weaver, seven long spokes and one short spoke. [Stop. See if all have correct number.] Now take four long spokes between the thumb and forefinger of the left hand like I have them here. [Show how this is done.] Then take three long spokes and place them across the up and down spokes [show this]; then take a piece of weaver and place it on top the cross-spokes with the end pointing to your right. [Show this. Examiners go around the room to see if all have the correct start.] Now you are ready to make your mat. Do not copy your neighbor's mat, for he may be wrong. When you are through bring your mat to me. Does everybody understand what to do? [Pause.] Ready! Begin!

The time taken for making each mat was noted by the examiner when the mats were brought to the table. A label was tied to each mat with the pupil's name, time, and form of instruction on it. Then all the mats for the group were strung together and tagged.

Each mat was scored in terms of the accuracy with which it was made. A score card giving a point for each step of the process was devised. The mats were then graded on a basis of the score card which follows.

PLATE I



A PERFECT MAT, SHOWING EACH ITEM OF THE SCORE CARD

SCORE CARD FOR REED MAT

1. Placements of spokes in border.....	15
2. Fastening of spokes in border.....	15
3. Shape of body of mat.....	10
4. Compactness with which body was woven.....	10
5. Direction of weaving in body.....	20
6. Number of rounds of weaver in tie.....	10
7. Compactness of tie.....	20
Total score.....	100

EXPLANATION OF THE SCORE CARD

(NOTE.—The mats were scored by a committee of three, H. Y. McCluskey, Miss M. Mueller, and Miss F. Metzger. Ten sample mats representing different degrees of correctness in each item of the score card were selected and used as standards for comparison in scoring all of the mats. This made the scoring more objective.)

1. The end of the spoke is inserted along the opposite side of the adjacent spoke. For each one inserted in any other place one point is deducted.
2. If the end of a spoke is not fastened one point is subtracted. Since each spoke may earn 2 points in its border position and there are 15 spokes in the border, the border is given a total of 30 points.
3. The body of the correct mat is both flat and circular. The score of a mat with an extreme cup or oblong shape is reduced 10 points. The amounts to be deducted for the various degrees of flatness and oblongness are determined by a comparison of the mat being scored with one of the ten sample standard mats.
4. The body of the mat is compactly woven. There should be no space between any of the strands from the tie to the border. Ten points may be deducted for looseness of weaving. The amounts to be deducted for the various degrees of looseness are determined by a comparison of the mat being scored with one of the ten sample standard mats.
5. The direction of the weaving is under and over each spoke. If the weaver runs under one spoke the adjacent weaver must run over the same spoke. For every other weaver that follows an adjacent weaver instead of alternating under and over, one point is deducted. That is, if four rounds of weaver follow one another, 2 points are subtracted, if six follow, 3 points are subtracted, and so on. When the weaver is wound around the tie, merely extending the tie, no credit is given for the proper direction of weaving, or compactness of weave since, strictly speaking, there is no weave.

6. For every round of weaver in the tie more or less than four, one point is deducted up to 10 points.
7. A tie is correctly made if the four rounds of the weaver are rightly drawn around the spokes at the center, and if the spokes are flat and in proper position. Since the compactness of the tie is important 20 points are deducted for an extremely loose tie. The amounts to be deducted for the various degrees of looseness are determined by a comparison of the mat being scored with one of the ten sample standard mats.

RESULTS OF BOX EXPERIMENT

The data obtained in all the experiments are presented in Tables I, II, III, IV, and V respectively. The comparisons in Experiment 1 were made between three forms of instruction, film, slide, and demonstration. The experiment was first carried out with the combined IV and V B grades in the Weber School, Urbana, Illinois. It was repeated in the same school with the combined V A and VI grades and repeated a second time with the V B Grade at the North Doan School, Cleveland, Ohio.

The type of instruction is indicated in the first column by the word slide, or film, or demonstration. The second column indicates the grade from which the subjects were taken, the third, the number of pupils in each group, the fourth, the average age of each group in years, the fifth, the average time it took to make the box, the sixth, the average point score for the group, the seventh, the mean deviation of the point score, the eighth, an index of the relationship between the point score and time in terms of s/t , and the ninth column shows the percentage of superiority in the average point score of each group over the lowest average point score made by a group in that grade.

To check the reliability of the experiment, the relative standing of the groups, according to the type of instruction, should be compared in each of the three sub-experiments. It will be found by inspection of Table I that the score made by the slide group was lowest; that the score made by the film group was next; and that the demonstration group made the highest average point score in each sub-experiment. This shows that if

the experiment were ever repeated under the conditions herein set forth, in all probability it would produce the same results.

TABLE I

TABULATION OF SCORES MADE BY THE GROUPS IN BOX EXPERIMENT I. THIS EXPERIMENT WAS CARRIED OUT THREE TIMES WITH THREE SETS OF PUPILS, TWO SETS FROM THE WEBER SCHOOL, URBANA, THE THIRD SET FROM THE NORTH DOAN SCHOOL, CLEVELAND

Group	Grade	Number of Pupils	Average Age Years	Average Time to Make Box	Average Score	Mean Deviation of Score	Average Score Divided by Average Time	Per Cent Average Scores Are Over Lowest Average Score
Weber School, Urbana, Illinois								
A. Slide.....	{ IV and V B	18	10.4	10.5	18.70	3.16	1.77	0.00
B. Demonstration..	{ IV and V B	18	10.4	9.18	23.50	2.55	2.55	25.66
C. Film.....	{ IV and V B	18	10.4	11.40	23.10	3.08	2.02	23.52
Weber School, Urbana, Illinois								
A. Slide.....	{ V A and VI	17	11.5	9.61	19.41	3.68	2.02	0.00
B. Demonstration..	{ V A and VI	17	11.8	8.45	23.58	2.50	2.79	21.43
C. Film.....	{ V A and VI	17	11.8	12.04	21.41	4.57	1.77	10.30
North Doan School, Cleveland, Ohio								
C. Slide.....	V B	18	10.60	9.20	18.10	3.25	1.96	0.00
B. Demonstration..	V B	18	10.50	5.90	20.80	1.59	3.52	14.91
A. Film.....	V B	18	10.60	11.10	18.50	2.28	1.66	2.20

By totaling the scores made by the groups in each sub-experiment the combined score of each instructional group was

tabulated as shown in Table II. Thus a summary of Experiment 1 is obtained.

The results of Experiment 1 as set forth in Table II show that the groups taught by the demonstration method are far superior in making a pasteboard box to the groups taught by either the film or slide methods. The average point score made by the demonstration groups is 19.91 per cent higher than that made by the slide group and 7.91 per cent higher than that made by the film group. The film groups in turn made an average score 12 per cent higher than the slide groups.

TABLE II

THE AVERAGE COMBINED SCORES MADE BY EACH INSTRUCTIONAL GROUP IN BOX EXPERIMENT 1. THIS TABLE WAS DERIVED FROM TABLE I BY CONDENSING THE RESULTS FROM THE THREE SUB-EXPERIMENTS INTO ONE SET OF SCORES

Instructional Group	Grade	Total No. of Pupils	Average Age Years	Average Time to Make Box	Average Score	Average Score Divided by Average Time	Per Cent Average Scores Are Over Lowest Average Score
Demonstration..	4-6	53	10.88	8.06	22.49	2.79	19.91
Film.....	4-6	53	10.90	11.52	21.02	1.82	12.00
Slide.....	4-6	53	10.81	9.81	18.75	1.91	0.00

The average time spent by the groups in making the boxes shows that the demonstration groups again are superior, for they not only made better boxes but they made them in a shorter time than did either the film or slide groups. A study of the relationship of the speed and accuracy with which the groups in Experiment 1 made boxes shows that speed accompanies both the ability to do the act well and the ability to do the act poorly, when each extreme is compared to the central tendency.

Box Experiment 2 consisted of a comparison of the demonstration, stereograph, film, and slide methods of instruction. The experiment was conducted first with a set of VA pupils at the North Doan School in Cleveland, Ohio, and was then repeated with sets of VIB and VIA pupils in the same school. This

experiment differed from Experiment 1 in that the stereograph method of instruction was added. Table III shows the results of each sub-experiment. In each set the rank of the groups by average score is first demonstration, second stereograph, third film, and fourth slide, with the exception of the VIA set in which the film group surpassed the stereograph group by .3 of 1 point.

TABLE III

THE TABULATION OF SCORES MADE BY THE GROUPS IN BOX EXPERIMENT 2. THIS EXPERIMENT WAS CARRIED OUT THREE TIMES WITH THREE SETS OF PUPILS FROM THE NORTH DOAN SCHOOL, CLEVELAND, OHIO

Group	Grade	Number of Pupils	Average Age Months	Average Time to Make Box	Average Score	Mean Deviation	Average Score Divided by Average Time	Per Cent Average Scores Are Over Lowest Average Score
North Doan School, Cleveland, Ohio								
A. Demonstration..	V A	16	11.07	6.75	22.0	0.00	3.26	19.56
B. Slide.....	V A	16	11.61	10.60	18.4	1.86	1.73	0.00
C. Film.....	V A	16	11.50	7.75	18.4	2.30	2.37	0.00
D. Stereograph....	V A	16	11.61	5.00	20.5	1.69	4.10	11.41
North Doan School, Cleveland, Ohio								
A. Demonstration..	VI B	16	11.80	6.01	21.8	.42	3.62	17.83
B. Slide.....	VI B	16	11.80	6.50	18.5	3.80	2.74	0.00
C. Film.....	VI B	16	11.82	4.70	20.8	1.35	4.42	12.43
D. Stereograph....	VI B	16	11.82	5.10	21.1	.98	4.10	14.05
North Doan School, Cleveland, Ohio								
A. Demonstration..	VI A	15	12.56	4.70	21.7	.48	4.61	19.88
B. Slide.....	VI A	15	12.58	6.80	18.1	3.31	2.66	0.00
C. Film.....	VI A	15	12.56	3.68	19.8	2.40	5.36	9.39
D. Stereograph....	VI A	15	12.55	4.21	19.5	1.96	4.64	7.73

The combined score of each instructional group was obtained by totaling the scores made by the groups in each set or sub-experiment. These combined scores were averaged and tabulated in Table IV. It will be seen that the demonstration, stereograph, film, and slide groups range from highest to lowest in the order named. The seventh column in Table IV shows the demonstration groups to be 18.77 per cent higher than the slide

groups, 13.23 per cent higher than the film groups, and 7.01 per cent higher than the stereograph groups. The relationship between the demonstration, film, and slide groups is the same in Experiment 2 as in Experiment 1, which is additional evidence of the reliability of the box experiments.

The most interesting result obtained from Experiment 2 is found in the performance of the stereograph groups. The groups taught by the stereograph method made an average score second only to that made by the demonstration groups. Furthermore, the stereograph groups took the shortest average

TABLE IV

THE AVERAGE COMBINED SCORES MADE BY EACH INSTRUCTIONAL GROUP IN BOX EXPERIMENT 2. THIS TABLE WAS DERIVED FROM TABLE III BY COMBINING THE RESULTS FROM THE THREE SUB-EXPERIMENTS INTO ONE SET OF SCORES

Instructional Group	Grade	Total No. of Pupils	Average Age in Years	Average Time to Make Box	Average Point Score	Average Score Divided by Average Time	Per Cent Average Scores Are over Lowest Average Score
Demonstration....	5-6	47	11.97	6.61	21.83	3.30	18.77
Stereograph.....	5-6	47	12.00	4.76	20.40	4.08	10.93
Film.....	5-6	47	11.95	5.55	19.28	3.47	4.88
Slide.....	5-6	47	11.98	8.00	18.38	2.29	0.00

time to make the boxes. In view of the fact that making a pasteboard box involved an act of motion, it might be thought that the methods of instruction where motion was used, namely, the demonstration and film, would prove to be most effective, but this was not the case in Experiment II. The stereograph method proved to be 5.83 per cent more effective than film instruction.

Up to this point we have presented only a terse account of the general results obtained from Box Experiments 1 and 2. A more detailed analysis of the results follows. If the reader will re-examine the score card by which the boxes were scored (see p. 316) it will be found that a tabulation of the errors

made in making the boxes is very simple. By making such a tabulation we can study the errors typical of the various method of instruction. This study was carried forward and the results tabulated in Table V.

TABLE V
ANALYSIS OF ERRORS IN BOX EXPERIMENTS

KIND OF INSTRUCTION	CREASES	STRIPS	FLAPS		
			Cutting		Fastening
			Length	Place	
Demonstration..... Stereoscope..... Film..... Slide.....	Cleveland				
	.....	.....	.....	3	.....
	4	.....	.....	1	1
	17	6	8	23	1
	35	9	19	34	21
	Urbana				
	.....	.....	.....	21	23
	9	2	.....	21	23
	20	2	4	23	32
	48	14	8	43	75

EXPLANATION OF TABLE V

In the Cleveland experiments an analysis was made only of the boxes containing more than two errors. Those showing minor mistakes were disregarded. In the Urbana experiments every box was examined. This fact accounts for the larger scores in the lower half of Table V.

Preliminary to any interpretation of Table V, it should be made clear that the errors indicated are not equally significant. For instance, a mistake in fastening a flap in itself usually makes little difference in the shape of the box, while mistakes in creasing, in removing strips, and in cutting the length of the flaps produce crude distortions.

The first fact shown by the table is that the demonstration and stereograph groups not only made comparatively few mistakes of any kind, but made those which are least important. On the other hand the film and slide groups erred much more frequently and certainly more flagrantly. And of the latter two groups, the slide group made far more errors in almost every phase of the box construction.

At first thought one would attribute the poor performance of the slide groups to the lack of motion in that type of instruction. While this may in part be true, yet the film group, instructed largely by motion, and not so

faulty as the slide group, is much worse than the stereograph group where all motion was eliminated.

This apparent contradiction may be explained by pointing out that the act of creasing is a simple operation with which every child is undoubtedly more or less familiar. Hence motion per se was not indispensable in forming a serviceable idea of the construction of a box. Then in view of the large number of mistakes in creasing made by the film and slide groups as compared to the number of similar mistakes made by the demonstration and stereograph groups, it is probable that the pronounced "relief" or three-dimension effect of the stereograph and demonstration presentations in contrast to the relatively flat surface of the slide and motion picture accounts for the better performance of the groups receiving the former type of instruction.

As mentioned above, a mistake in fastening a flap per se does not disfigure a box very much, but when this mistake is combined with errors in creasing, in removing strips, and in cutting the length of the flaps a very distorted box is inevitably the result. The lower half of Table V indicates that in the demonstration groups there was a rather large number of mistakes in fastening flaps but these were not accompanied by a corresponding number of mistakes in creasing or cutting the length of the flaps. Hence, we find that in these groups the boxes, though defective in some points, were not, as a rule, badly deformed. On the other hand in the film and slide groups there were numerous mistakes not only in one item but in many. In view of this contrast it seems reasonable to conclude that the film and slide presentation had a marked tendency to produce a hazy, disconnected, and incomplete picture of the process as a whole.

In conclusion, this analysis of errors shows three things:

1. The stereograph and demonstration groups made not only fewer errors, but those of least importance.
2. The advantage of the stereograph and demonstration presentation is due to the "relief" or pronounced three-dimension effect of these types of instruction.
3. The film and the slide instruction failed in many cases to give a clear, consecutive conception of the process of box construction as a whole.

RESULTS OF THE MAT EXPERIMENTS

Experiments 3, 4, and 5 were carried forward in the Weber School, Urbana, Illinois, and the North Doan School, Cleveland, Ohio, parallel to Experiments 1 and 2. The same groups of pupils were used. These latter experiments dealt with the subject "How to Make a Reed Mat."

A comparison of three forms of instruction, film, slide, and demonstration were made in Experiment 3. The experiment was first carried out with the combined IV and VB grades in the Weber School, Urbana, Illinois. Then it was repeated three times, first in the same school with the combined VA and VIA grades, second with the VIB grade at the North Doan School, Cleveland, Ohio, and third with the VIA grade of the latter school.

An inspection of the average scores made by the groups in each set or sub-experiment shows that the demonstration groups rank first in each of the four sets (see Table VI). The film groups rank second in two sub-experiments, and third in the other two, changing ranks in the latter case with the slide groups. However, the advantage of the slide groups over the film groups is not as great as the superiority of the film groups over the slide groups in the other two sets. Hence, when the total scores for the four sub-experiments are combined and new averages calculated we find an advantage of 5.74 per cent for the film groups over the slide groups. This is shown in Table VII.

The results obtained by combining the scores of the four sub-experiments demonstrate the decided superiority of the demonstration method over the film and slide methods. The demonstration groups made an average score 34.82 per cent higher than the slide groups, and 27.50 per cent higher than the film groups, and consumed a smaller average time than either of the other groups. It is interesting to note the similarity of the results obtained in Experiments 1 and 3 even when different units were taught and different groups were used. (Compare Tables II and VII.)

Experiment 4 compared the demonstration, film, and stereograph types of instruction. This experiment was first carried out in Grade VB of the North Doan School, Cleveland. It was repeated three times, first in Grade VA, second in Grade VIB, and lastly in Grade VIA. The scores made by the various groups are tabulated in Table VIII.

TABLE VI

TABULATION OF SCORES MADE BY THE GROUPS IN MAT EXPERIMENT 3. THIS EXPERIMENT WAS CARRIED OUT FOUR TIMES WITH FOUR SETS OF PUPILS, TWO SETS FROM THE WEBER SCHOOL, URBANA, AND TWO FROM THE NORTH DOAN SCHOOL, CLEVELAND

Group	Grade	Number of Pupils	Average Age Years	Average Time to Make Mat	Average Score	Mean Deviation of Score	Average Score Divided by Average Time	Per Cent Scores Are over Lowest Score
Weber School, Urbana, Illinois								
A. Demonstration..	{ IV and V B	19	10.31	52.20	35.31	19.39	.67	287.17
B. Film.....	{ IV and V B	19	10.30	54.05	14.80	11.80	.27	62.28
C. Slide.....	{ IV and V B	19	10.33	42.06	9.12	7.19	.21	0.00
Weber School, Urbana, Illinois								
A. Demonstration..	{ V A and VI	20	11.92	55.35	48.71	18.44	.88	8.68
B. Film.....	{ V A and VI	20	11.71	53.75	44.82	21.44	.83	0.00
C. Slide.....	{ V A and VI	20	11.90	58.90	46.90	18.60	.79	4.64
North Doan School, Cleveland, Ohio								
B. Demonstration..	VI B	16	11.66	42.5	57.8	26.9	1.35	28.72
A. Film.....	VI B	16	11.66	41.7	56.8	10.3	1.38	26.11
D. Slide.....	VI B	16	11.70	45.7	46.8	14.2	1.12	0.00
North Doan School, Cleveland, Ohio								
B. Demonstration..	VI A	15	12.33	30.99	61.90	9.36	1.91	41.61
A. Film.....	VI A	15	12.35	34.06	43.71	10.91	1.28	0.00
C. Slide.....	VI A	15	12.35	40.07	48.91	9.90	1.22	11.23

The demonstration groups in Experiment 4 made a combined average score 27.53 per cent higher than the stereograph groups and 4.69 per cent higher than the film groups and in less time

TABLE VII

THE AVERAGE COMBINED SCORES MADE BY EACH INSTRUCTIONAL GROUP IN MAT EXPERIMENT 3. THIS TABLE WAS DERIVED FROM TABLE VI BY COMBINING THE RESULTS FROM THE FOUR SUB-EXPERIMENTS INTO ONE SET OF SCORES

Group	Grade	No. of Pupils	Average Age in Years	Average Time to Make Mat	Average Score Made on Mat	Average Score Divided by Average Time	Per Cent Average Scores Are over Lowest Average Score
Demonstration....	4-6	70	11.51	46.28	49.98	1.08	34.82
Film.....	4-6	70	11.45	48.58	39.20	.80	5.74
Slide.....	4-6	70	11.53	46.71	37.07	.79	0.00

TABLE VIII

TABULATION OF SCORES MADE BY THE GROUPS IN MAT EXPERIMENT 4. THIS EXPERIMENT WAS CARRIED OUT FOUR TIMES WITH FOUR SETS OF PUPILS ALL FROM THE NORTH DOAN SCHOOL, CLEVELAND, OHIO

Group	Grade	Number of Pupils	Average Age Years	Average Time to Make Mat	Average Score	Mean Deviation	Average Score Divided by Average Time	Per Cent Scores Are over Lowest Score
A. Demonstration..	VB	17	10.59	54.6	50.4	12.02	.92	10.04
B. Film.....	VB	17	10.49	64.8	51.5	15.20	.80	11.78
C. Stereograph....	VB	17	10.55	67.8	45.8	18.03	.67	0.00
B. Demonstration..	VA	16	11.62	43.10	46.10	18.48	1.06	14.96
D. Film.....	VA	16	11.62	41.28	53.37	12.38	1.29	33.09
C. Stereograph....	VA	16	11.52	35.50	40.10	15.21	1.12	0.00
B. Demonstration..	VI B	16	11.66	42.5	57.8	26.9	1.35	50.91
A. Film.....	VI B	16	11.66	41.7	56.8	10.3	1.38	48.30
C. Stereograph....	VI B	16	11.66	50.3	38.3	18.03	.76	0.00
B. Demonstration..	VI A	15	12.33	30.99	61.90	9.36	1.91	41.61
D. Film.....	VI A	15	12.35	34.06	43.71	10.91	1.28	0.00
A. Stereograph....	VI A	15	12.35	50.31	44.81	13.60	.89	2.54

than was taken by the groups taught by the other methods. The most notable result shown in Table IX, however, is the poor performance made by the stereograph groups. This performance

is in direct contrast to the results of Box Experiment 2, where the stereograph groups ranked second only to the demonstration groups. Before we attempt to explain the difference, let us study the scores made in Mat Experiment 5.

Experiment 5 compared the demonstration, film, slide, and stereograph methods of instruction. The experiment was carried out twice, first in Grade VIB and second in Grade VIA of the North Doan School, Cleveland. The results of Experiment 5 are tabulated in Table X.

An inspection of Table X shows us that the stereograph groups rank last in the VI B set and next to last in the VI A set.

TABLE IX

THE AVERAGE COMBINED SCORES MADE BY EACH INSTRUCTIONAL GROUP IN MAT EXPERIMENT 4. THIS TABLE WAS DERIVED FROM TABLE VIII BY COMBINING THE RESULTS FROM THE FOUR SUB-EXPERIMENTS INTO ONE SET OF SCORES

Group	Grade	No. of Pupils	Average Age in Years	Average Time to Make Mat	Average Score Made on Mat	Average Score Divided by Average Time	Per Cent Average Scores Are over Average Lowest Scores
Demonstration....	5-6	64	11.52	41.65	53.92	1.29	27.53
Film.....	5-6	64	11.50	45.00	51.50	1.14	21.80
Stereograph.....	5-6	64	11.49	50.48	42.28	.82	0.00

The stereograph groups rank last in both sub-experiments in terms of average score divided by average time. In short, when we combine the total scores made by each group in the two sub-experiments, and calculate the new averages, we find that the slide groups made an average score 15.33 per cent higher than the stereograph groups, that the film groups are 21.69 per cent higher, and that the average scores made by the demonstration groups are 44.16 per cent higher than the scores made by the stereograph groups (see Table X).

A comparison of the results obtained from Experiments 2 and 5 show that the relationship between the demonstration,

film, and slide groups is the same in each experiment but that the stereograph groups ranked second to the demonstration groups in Experiment 2 and last in Experiment 5. An analysis of the two teaching situations may explain this difference. The

TABLE X

TABULATION OF SCORES MADE BY THE GROUPS IN MAT EXPERIMENT 5. THIS EXPERIMENT WAS CARRIED OUT TWICE WITH ONE SET OF PUPILS FROM EACH OF THE VIB AND VIA GRADES OF THE NORTH DOAN SCHOOL, CLEVELAND, OHIO

Group	Grade	Number of Pupils	Average Age Months	Average Time to Make Mat	Average Score	Mean Deviation	Average Score Divided by Average Time	Per Cent Scores Are over Lowest Score
B. Demonstration..	VI B	16	11.66	42.50	57.80	26.90	1.35	50.91
A. Film.....	VI B	16	11.66	41.70	56.80	10.30	1.38	48.30
D. Slide.....	VI B	16	11.70	45.70	46.80	14.20	1.12	22.19
C. Stereograph....	VI B	16	11.66	50.30	38.30	18.03	.76	0.00
B. Demonstration..	VI A	15	12.33	30.99	61.90	9.36	1.91	41.61
D. Film.....	VI A	15	12.35	34.06	43.71	10.91	1.28	0.00
C. Slide.....	VI A	15	12.35	40.07	48.91	9.90	1.22	11.23
A. Stereograph.....	VI A	15	12.35	50.31	44.81	13.60	.89	2.54

TABLE XI

THE AVERAGE COMBINED SCORES MADE BY EACH INSTRUCTIONAL GROUP IN MAT EXPERIMENT 4. THIS TABLE WAS DERIVED FROM TABLE X

Group	Grade	Number of Pupils	Average Age in Years	Average Time to Make Mat	Average Score Made on Mat	Average Score Divided by Average Time	Per Cent Average Scores Are over Lowest Average Score
Demonstration....	5-6	31	11.99	36.93	59.80	1.61	44.16
Film.....	5-6	31	11.99	38.67	50.48	1.30	21.69
Slide.....	5-6	31	12.02	41.71	47.84	1.14	15.33
Stereograph.....	5-6	31	11.99	48.68	41.48	.85	0.00

function of the motion used in explaining how to make a reed mat is different from that used in making a pasteboard box. First, all pupils are familiar with the process of folding paper or cardboard but they are not so familiar with the weaving of a mat.

Second, the slide groups were taught the motion used in weaving a mat by means of a pointer on the screen whereas the stereograph groups had to imagine the motion of weaving from the description of that process told verbally by the instructor. In explaining to the stereograph groups how to make a pasteboard box the child's familiarity with the process of folding was no obstacle to a clear understanding of the process. In addition to the difference in the function of motion in the two processes is the fact that a box involves more of three-dimensional space than the flat mat, and the analysis of errors made in the box experiments would show that the stereograph groups were able to secure a better image of the creases in the box than did the film or slide groups. All of these factors, then, would explain the marked difference in the results of the instruction with stereographs in Experiments 2 and 5.

While we were preparing the mat film for these experiments an expert teacher of reed basketry happened to be an interested spectator of the procedure. She expected the film to be more effective than the demonstration in teaching the activity to groups, because she found in her experience that it was difficult to demonstrate to more than five to ten pupils at a time. Her contention was that the pupils on the outside of the demonstration semi-circle could not see the process well enough to become adept in making the mat without considerable coaching afterward, while all pupils could see the screen with equal effectiveness.

The original number of pupils taught in each group in Experiments 3-5 was twenty-eight to thirty. The process of matching the pupils age for age and grade for grade to secure comparable groups cut the groups to fifteen to twenty pupils. The demonstration groups, then, were about three times as large as this teacher's experience led her to believe they should be, for teaching reed basketry by the demonstration method. Hence, the effectiveness of the film method as contrasted with the demonstration method should be carefully studied. Table XII gives the average combined total scores made by the demonstration groups and the film groups from Experiments 3-5 inclusive.

The data given in Table XII show that the demonstration method is 17.78 per cent more effective than the film method in teaching "How to Make a Reed Mat" in spite of the fact that all pupils were not in a position to view the demonstration as closely

TABLE XII

THE AVERAGE COMBINED TOTAL SCORES MADE BY THE DEMONSTRATION GROUPS AND THE FILM GROUPS FROM EXPERIMENTS 3-5 INCLUSIVE

Group	Grade	Number of Pupils	Average Age in Years	Average Time to Make Mat	Average Score Made on Mat	Average Score Divided by Average Time	Per Cent Average Scores Are over Lowest Average Score
Demonstration....	4-6	103	11.38	46.26	49.47	1.07	17.78
Film.....	4-6	103	11.36	48.06	42.00	.87	0.00

as others on the front row. Furthermore, the demonstration groups took 3.89 per cent less time to make their mats than did the film groups. Here is one instance where the superiority of the screen for teaching larger groups does not appear and is another bit of evidence to show that a scientific experiment sometimes indicates the incorrectness of even expert observation.

SUMMARY AND CONCLUSIONS

BOX EXPERIMENTS

1. In teaching pupils how to make a pasteboard box the demonstration, stereograph, film, and slide rank in effectiveness from highest to lowest in the order named.

2. The superiority of the stereograph over the film and slide appears to be due to the relief or three-dimensional effect in this type of instruction.

3. The demonstration and stereograph groups made errors of least importance as compared to the errors made by the film and slide groups.

4. The superiority of the demonstration appears to be due to the personal presence of the teacher and to the fact that pupils

watching the process can see the real box and thus grasp the detailed steps in the process.

MAT EXPERIMENTS

5. In teaching pupils how to make a reed mat the demonstration, film, slide, and stereograph rank in effectiveness from highest to lowest in the order named.

6. The superiority of the demonstration as in the box experiments appears to be due to the personal presence of the teacher.

7. The inferiority of the stereograph in the mat experiments as contrasted with the box experiments is perhaps due to the fact that flat pictures of the mat bring out in sufficient relief the positions of the reed in relation to one another, thus showing which of the reeds are in front and which behind the weaver.

8. Motion does not appear to be necessary to give a clear idea of how the acts of making a mat are carried out, in view of the slight superiority of the film over the slide and stereograph.

CHAPTER IX

A COMPARISON OF THE EFFECTIVENESS OF A MOTION PICTURE FILM AND OF DEMONSTRATION IN INSTRUCTION IN HIGH-SCHOOL PHYSICS

E. C. ROLFE

The general problem which is illustrated in this experiment is discussed in the introduction to the experiments which are reported in chapter viii. It has been asserted that the motion picture presents certain advantage, over demonstration by the teacher. In the motion picture film, the representation can be seen with nearly equal distinctness by all the members of the class, whereas the demonstration may not be so clearly seen by some of the group as by others. The film, moreover, is organized and produced with the greatest care, whereas the instructor may not work at his maximum skill at all times. Finally the motion picture is enlarged, and this may perhaps give a better view than the demonstration. The experiments on this subject were therefore organized in order to determine whether these advantages outweighed the possible advantages of the teacher.

The film which was used in the present case is entitled *Static Electricity*. It was produced under the direction of Professor W. D. Henderson, and was obtained from the United Projector and Film Co.

The experiment was made with four sections of the first course in physics in the Northern High School of Detroit. The sections comprised, in all, over eighty students. In order to determine whether the groups were equal in intelligence the Army Alpha Test was given to all of them. It was found that the average score made by the four groups was approximately equal.

The experiment was conducted in the following manner. The first two sections were treated alike. They, at first, were

allowed one-half hour to study an assignment in the text on electrostatics. This subject was new to them. After this period of study they were shown the motion picture film twice, each time taking about fifteen minutes. Immediately afterward they were given a test consisting of twelve questions upon the film, and were given thirty minutes to answer the questions. The scores on this test constitute the first measure of the effectiveness of the film.

A question may be raised concerning the adequacy of a verbal test to measure what has been learned in a scientific subject. Accordingly, on the following day a second test was made. This test was conducted in the following manner. Students were assembled in the laboratory. Without previous warning they were required to repeat the procedure which had been shown them in the film. The class was divided into groups of four each. To each group were assigned eight experiments of a simple nature. One of the four students was required to demonstrate the first experiment. The other three were then required to state whether the experiment was correct. Each of the others also demonstrated each of the experiments. In this way the opportunities to perform the experiment first in the group were equally distributed so that each student had two chances to make the first demonstration. If the student made the correct demonstration when he was first he was given 2 points. If he made the correct demonstration when he was not first he was given 1 point. The possible score then, consists of 2 points each on two experiments, and 1 point each on six other experiments, making a possible score of 10.

In Sections 3 and 4 the preliminary reading assignment was made as in Sections 1 and 2. Immediately following this reading assignment the instructor demonstrated with apparatus, and lectured on the same subject-matter that was contained in the motion picture. The apparatus which was used in this demonstration was as nearly as possible of the same kind as that used in producing the motion picture. This demonstration and lecture lasted for one-half hour. The time, therefore, was the

same in the four groups. Finally the third and fourth groups were given exactly the same examination, consisting of the written test and a laboratory test, as was given to the first two groups.

TABLE I
DISTRIBUTION OF THE SCORES OF THE MOTION PICTURE
AND DEMONSTRATION GROUPS IN THE
WRITTEN TESTS

Scores	Motion Picture Group	Demonstration Group
25-29.....	2	0
30-34.....	2	0
35-39.....	0	0
40-44.....	3	0
45-49.....	0	0
50-54.....	3	0
55-59.....	3	1
60-64.....	0	0
65-69.....	6	4
70-74.....	0	0
75-79.....	9	10
80-84.....	8	8
85-89.....	0	0
90-94.....	1	7
95-100.....	1	12
Average.....	65.8	85.3

TABLE II
DISTRIBUTION OF THE SCORES OF THE MOTION
PICTURE AND DEMONSTRATION GROUPS
IN THE LABORATORY TESTS

Scores	Motion Picture Group	Demonstration Group
40.....	2	1
50.....	4	0
60.....	9	1
70.....	8	2
80.....	9	18
90.....	6	7
100.....	0	13
Average.....	69.7	85.9

The results of the experiments are presented in Tables I and II. Each of these tables shows the distribution of the scores of the pupils in Groups 1 and 2 taken together, and in Groups 3

and 4 taken together. The first table shows the scores in the written test and the second table in the laboratory test.

The difference in the scores made by the motion picture group and the demonstration group is strikingly large and is greater than in most of the experiments which have been made in education. In the first test the motion picture group averaged 65.8, and the demonstration group 85.3. In the laboratory test the average of the motion picture group was 69.7 and of the demonstration group 85.9. The similarity in the averages for the two tests makes it clear that the difference was a real difference and not one which was due to the nature of the tests themselves. It is quite clear that in this case the demonstration by an instructor is markedly superior to viewing the same procedure in a motion picture film. The superiority of demonstration has appeared in all the experiments in which it has been compared with the motion picture. This is one of the most positive findings of the investigation. It appears that whatever are the advantages of the motion picture film in teaching how to perform an activity or in showing how an act is carried out, they are outweighed by other advantages which inhere in the process of teaching by a living teacher.

It was planned to carry on a second experiment with a moving-picture film entitled *Current Electricity*, but the film was so badly torn up and damaged that it could not be used and there was not time to secure another.

CHAPTER X

THE EFFECTIVENESS OF THE MOTION PICTURE, DEMONSTRATION BY THE TEACHER, AND ORAL INSTRUCTION IN TEACHING COOKING

A. P. HOLLIS

The subject of the lesson was "How to Make an Omelet," and the film used was also entitled *How to Make an Omelet*.¹

This experiment is considered of limited validity because certain phases of it, it was discovered later, were not properly controlled; other phases, however, were scientifically conducted, and merit consideration.

The experiment was performed by three teachers in the schools of Oak Park, Illinois. The first of these operated under proper conditions, and the results are valid for the groups tested. The procedure was as follows.

Pupils of Grade VIIA were divided by the supervisor of home economics into three groups which, in her judgment, were of equal ability. While ages and intelligence ratings were available for most of these pupils, the number of missing scores made precise pairing impossible. As the reports for this series were nearly due, it did not seem advisable to wait for new intelligence tests, as former experience showed it meant a considerable delay. Moreover, in the two previous experiments, scores from the groups matched by intelligence ratings, and from the groups divided according to the teacher's judgment, seemed to tally so closely that the validity of the experiment was not affected.

These children had not made omelets before, either in school or at home. The first group was shown for eight minutes the film *How to Make an Omelet*. They then went immediately to the school kitchen, and without further instruction or questions,

¹ From the Gibson Studio, Casselton, North Dakota.

proceeded to make the omelet entirely from the directions and pictures shown in the film.

The second group was taught orally by the same teacher for eight minutes, and made the omelet without having seen the film, entirely from the oral presentation. They also were not allowed to ask further questions or receive further instruction.

The third group was given a demonstration lesson, with oral instruction, by the same teacher, in the same length of time; and at once proceeded, in the manner followed by the other groups, to make the omelet.

The same teacher scored all the omelets on three qualities of merit, namely: taste, texture, and degree of brownness; with results as follows:

TABLE I

PERFORMANCE SCORES OF VII A PUPILS ON THE MAKING OF AN OMELET, GROUP 1 RECEIVING INSTRUCTION FROM A MOTION PICTURE FILM, GROUP 2 FROM ORAL INSTRUCTION, AND GROUP 3 FROM A DEMONSTRATION LESSON

1. Film group (8 pupils)	82.50 per cent
2. Oral group (8 pupils)	76.25 per cent
3. Demonstration group (12 pupils)	85.83 per cent

Here the film occupies a middle position in teaching value, as compared with purely oral instruction and instruction by demonstration. It scored 6.25 per cent ahead of the oral instruction and 3.33 per cent behind the demonstration.

The three remaining tests with the omelet film are given below, but only the comparisons involving the same grade of pupils can be considered of value.

In Miss B's experiment comparisons are permissible between the two VII A groups, using film and oral instruction respectively. The film alone scored 2.45 per cent ahead of the oral instruction alone.

In Miss C's first experiment, similarly, we can compare only the VII A groups. Here oral instruction resulted in a superiority of 4.7 per cent above the film. In her second experiment, there is no other VII A group to match the score of 88.85 per cent attained with the film.

The oral-demonstration method in each of the last three cases was used with a grade five months ahead of VII A. The VIII B pupils would be five months more matured in age, and would have had five months more experience in cooking both at home and in school. The use of the VIII A groups was made in the absence of the experimenter, and the conditions specified were evidently misunderstood.

TABLE II
SCORES OF PUPILS IN MAKING AN OMELET AFTER INSTRUCTION
BY THREE METHODS

TEACHER	FILM GROUP		ORAL GROUP		DEMONSTRATION GROUP	
	Grade	Score	Grade	Score	Grade	Score
Miss B.	VII A	87.81	VII A	85.36	VIII B	89.00
Miss C.	VII A	81.56	VII A	86.26	VIII B	94.35
Miss C.	VII A	88.85	VIII B	90.00	VIII B	95.00

Summing up the results secured with the performance test in cooking, we may repeat that in the one experiment where the three groups were of the same grade, and all other conditions uniform, the film alone secured better results than oral instruction alone, but not as good results as where oral instruction was combined with demonstration.

In the three other experiments, the grades were not kept uniform; the demonstration lessons were given to advanced grades and had to be thrown out of consideration. In two of these experiments, however, the grades remained constant for the film and oral groups. In these two, the film lost out in one case, and won out in the other. Thus there were three experiments in all, in which the film alone was matched against oral instruction alone and the response was a manipulative one instead of a verbal. The film proved to be the better medium in two of the three cases. In the two cases in which the oral lesson was compared with demonstration, the demonstration was superior.

CHAPTER XI

AN EXPERIMENT IN THE USE OF STEREOGRAPHS AND SLIDES IN TEACHING ORAL ENGLISH TO FOREIGNERS

NINA JOY BEGLINGER

The problem of teaching English to foreigners involves two relatively distinct elements. The first concerns the development of ability to read and to write, and the second the development of oral fluency. The literate adult foreigner gains the ability to read and to write relatively rapidly. Independent oral expression, however, is less easily acquired. The purpose of this experiment is to measure the effectiveness of pictures, in the form of stereographs and slides, as means of hastening the development of oral expression. The effectiveness of pictures was measured by comparing the progress made by four groups who used the pictures with four other groups who proceeded according to the regular method. The instruction continued for a period of six weeks, and thirty minutes each evening was devoted to the special development of oral fluency.

Pictures were selected to be used in this experiment which included objects which the students read about or wrote about in the rest of their instruction. The classes who used the pictures first studied the stereographs. On the back of these stereographs were printed brief themes dealing with the objects in the picture. There were thirty-five stereographs in all. The student was instructed to devise as many sentences as he could about the things which he saw in the picture. After the individual preparation by means of a stereograph the class was brought together in a group exercise. For this exercise it was shown slides which duplicated the pictures in the stereographs.

The classes which did not use the stereographs were taught in the usual manner. They used objects, dramatic representa-

tion, and pictures whenever it seemed convenient to make use of these devices. The instruction in reading and writing proceeded in the same fashion with all of the groups.

The groupings were made first on the basis of the stage of progress in English. All of the classes were made up of beginning students. The division into the experimental and parallel groups was made on the basis of age, sex, and apparent progress. The Pintner Non-Language Test was given to all of the students and the groups were compared on the basis of their scores in this test.

The gains made by the two groups of pupils was measured by presenting each student individually with 175 words, instructing him to make as many sentences as possible containing each of them. This test was made at the beginning and at the end of the instruction period and the measure of progress consisted in the difference between the initial scores and the final scores. These lists were available to all the teachers and students to use in classroom instruction.

The results of the experiment are summarized in Table I. This table shows the gain made by the groups who received the ordinary instruction and those who were taught by the aid of the stereograph and the slide. The table is to be interpreted as follows: in the control group where pictures were not used except incidentally, there were sixty-eight students. These students gave an average of 225 sentences, which included the 175 key words, in the initial test. In the final test they gave an average of 855 sentences, which showed a gain of 630 sentences. The percentage gain was 280. The number of correct sentences in the initial test was 144 and in the final test 482. The percentage of correct sentences in the initial test was 64 and in the final test 56. The loss in the percentage of correct sentences was 7.7.

The reader may readily interpret the remainder of the table. It is clear from the comparison of the two groups that the groups which used the stereographs and slides made a very much larger gain than those who did not use them. The gain was not only

TABLE I
COMPARISON OF THE GAINS MADE BY THE GROUP RECEIVING THE ORDINARY INSTRUCTION (G) AND
THE GROUP WHICH WAS TAUGHT WITH THE AID OF STEREOGRAPHS

Group	No. Cases	No. Sentences				No. Correct Sentences		Percentage Correct Sentences			Average Score on Intelligence Test
		Initial Test	Final Test	Gain	Percentage Gain	Initial	Final	Initial	Final	Loss in Percentage Correct	
Control group (without pictures)...	68	225	855	630	280	144	482	64	56.3	7.7	.....
Experimental group (with pictures)...	91	246	1,279	1,033	420	167	828	67.9	64.7	3.2	.....
Difference between control and experimental groups.....	.....	+ 21	+ 424	+ 403	+ 140	+ 23	+ 346	+ 3.9	+ 8.4	- 4.5	.....
Control group (select cases).....	50	256	869	613	239	149	481	58.2	54.6	3.6	166.5
Experimental group (select cases)...	50	246	1,269	1,023	415	169	819	64.0	63.7	.3	169.8
Difference between control and experimental groups.....	.....	- 10	+ 400	+ 410	+ 176	+ 20	+ 338	+ 5.8	+ 9.1	- 3.3	.....

in the number of correct sentences which were given, but also in the percentage of correct sentences.

In the lower part of the table are shown the results of fifty students from each group whose average intelligence score was practically the same. The results of the test in these two groups show practically the same superiority of the groups who saw the pictures as was shown in the total groups.

A count of the words used by the individuals in the control and the experimental groups indicates that the experimental group made a much greater gain in vocabulary as well as in the number of sentences which they used. The control group used 293 words on the first test and 507 words on the final test, a gain of 73 per cent. The experimental group used 313 words in the initial test and 737 words in the final test, a gain of 135 per cent.

It seems entirely clear from the results of this experiment that the use of stereographs is of great advantage in the development of the oral use of English in teaching adult foreigners. There may be some danger inherent in the use of this method by untrained teachers in case they overemphasize oral expression to the disadvantage of training in written expression and in reading; but if the proper balance is kept between these types of instruction, the systematic use of stereographs and slides for the development of oral fluency should be effective.

CHAPTER XII

AN EXPERIMENTAL COMPARISON OF THE METHODS OF ORAL AND FILM INSTRUCTION IN THE FIELD OF HEALTH EDUCATION

CAROLYN HOEFER AND EDNA KEITH

THE PROBLEM

Various experiments have been conducted to evaluate the motion picture in the field of education but these have been in such subjects as geography, history, etc., where the methods of testing results have emphasized only the pure informational objective. The purpose of all instruction should be not only to give information, but also to provide for its application. The effectiveness of the motion picture as a means of teaching health can only be successfully measured, therefore, when the study includes at least some measure of the influence of such instruction upon the daily lives of the children. This experiment has been organized to compare from the two standpoints of information gained and of habits formed, the method of oral instruction as ordinarily given in the classroom with the method of oral instruction plus film instruction. The problem has been divided into two distinct experiments.

THE DESCRIPTION OF THE EXPERIMENT

I. THE SUBJECTS

Experiment 1 included twenty-six fifth-grade groups in the Joliet (Illinois) public schools. In a few instances, there were a few fourth- and sixth-grade children included. These were cases in which there were combinations of fourth and fifth or of fifth and sixth grades and it was felt that the experiment would be more satisfactory if the instruction were given to the entire group. Altogether there were 865 children included in this experiment. Unfortunately an epidemic followed by a require-

ment from the State Board of Health that all children must be vaccinated greatly reduced the number of children who were present throughout the experiment, which lasted over a period of six weeks.

2. THE FILMS

Eight films were used in Experiment 1. They were:

1. *The Knowing Gnome.*

Produced by the American Red Cross.

2. *The Romance of the White Bottle.*

Produced by the Atlas Educational Film Co., Chicago.

3. *The Four M's.*

Produced by the University of Wisconsin.

4. *Milk, the Perfect Food.*

Produced by the University of Wisconsin.

5. *The Story of the Orange.*

Produced by the Southern California Fruit Growers' Association.

6. *Mrs. Brown and the High Cost of Living.*

Produced by the American Red Cross.

7. *Guard Your Mouth, the Gateway to Health.*

Produced by the National Dental Association.

8. *Toothache.*

Produced by the National Dental Association.

Difficulty was experienced in obtaining satisfactory films because the following qualifications had to be considered: (1) Adaptability to the interests of children of this age. (2) Emphasis upon the positive rather than the negative phase of health instruction. Many films bring out the disadvantages of ill health rather than the advantages of good health and the past experience of the Elizabeth McCormick Memorial Fund has proved that in dealing with children the latter method is superior. (3) Scientific accuracy as well as interest. Films produced for commercial purposes are not always scientific. (4) The films had to include health habits which could be measured at the close of the experiment. Not all of the films cited above fulfilled these conditions to a high degree. *The Story of the Orange*, for example, which was used to emphasize the value of fruit in the diet, was, perhaps, more of a geography film than a health film,

and its application to the daily lives of the children had to be made by the teacher.

3. METHOD USED IN EXPERIMENT I

There were fifteen schools involved in the experiment, and the division of the grades into the two groups depended upon several factors; first, the possibility of showing the film conveniently, and, second, such factors as nationality, social status, etc. An effort was made to have foreign children in both groups as well as children who had had social advantages.

The method in general was to teach the subject-matter which was contained in a film to both groups of children. Commonly the subtitles of the film were used as the basis of this instruction. The topics were discussed in the classes and all the children carried out various projects, such as finding illustrative pictures and making scrapbooks. Following this common instruction one group saw the film, and the parallel group reviewed the subject-matter.

The experiment was initiated Thursday, December 7, by weighing the children. On Friday, the following questionnaire was given to the children. It was also given at the end of the experiment in order that the gains made by the two groups might be compared.

QUESTIONNAIRE TO BE FILLED OUT BY EACH CHILD

(If you do not know the answer to the question leave it blank)

Name _____ School _____ Grade _____

Age on your last birthday _____ Date of birthday _____

1. At what time do you usually go to bed?
2. Do you drink coffee? How much?
3. Do you drink tea? How much?
4. Do you drink milk? How much?
5. Do you drink milk every day at school?
6. Do you eat cereals for breakfast? How many times a week?
7. Do you have milk on the cereal?
8. How many times a week do you go to school without your breakfast?
9. How many glasses of water do you drink every day?
10. How many times a week do you eat candy? At what time of the day?
11. Do you eat fruit every day?

12. Below is a list of the fruits. Underline once the fruits which you eat every day; underline twice the fruits which you eat at least once a week; underline three times the fruits which you like but do not eat frequently. The fruits, therefore, which are not underlined will be those which you do not like and which you do not eat.
Apples, bananas, grapes, grapefruit, lemons, limes, oranges, pears, prunes, raspberries, plums, cherries.
13. Below is a list of vegetables. Underline this list in the same manner as you did the list of fruits.
Beans, beets, cabbage, carrots, cauliflower, celery, cress, chard, cucumber, dandelion, eggplant, endive, legumes, lettuce, onions, parsnips, peas, potatoes (white), potatoes (sweet), radish, rhubarb, rutabaga, spinach, squash, turnips, tomatoes.
14. Do you sleep with your windows open?
15. How many hours of sleep should children of your age have?
16. Give reasons why children should drink milk:
a) ———. b) ———. c) ———. d) ———.
17. Do you brush your teeth every day? How many times a day?
18. How many glasses of water should one drink each day?

On Monday of each week clockfaces such as are found in Figure 1 were distributed to the pupils. On them they recorded the time they went to bed, the time they arose, and whether or not they had slept with their windows open. Records were kept for four weeks.

The following instructions were given to the teachers of both groups.

Monday, December 11.—One of the methods used by the motion picture to teach facts is the use of subtitles. The experiment might begin something like this: "I am going to give you a number of sentences which together will form a little story. These sentences are similar to the sentences which you read in a moving picture. As I give you the different sentences I am going to ask you to illustrate them with pictures. (These may be free-hand illustrations or pictures which have been brought in, in which case the subtitles would have to be given to the children on Friday so that they may hunt the appropriate pictures.) At the end of the story each child will have made its own 'film.'"

NAME _____ AGE _____
 SCHOOL _____ GRADE _____



MON. EVE.



TUES. MORN.
WINDOW OPEN?



TUES. EVE.



WED. MORN.
WINDOW OPEN?



WED. EVE.



THURS. MORN.
WINDOW OPEN?



THURS. EVE.



FRI. MORN.
WINDOW OPEN?



FRI. EVE.



SAT. MORN.
WINDOW OPEN?



SAT. EVE.



SUN. MORN.
WINDOW OPEN?



SUN. EVE.



MON. MORN.
WINDOW OPEN?

FIG. 1.—Form designed by Miss Keith, Elementary Supervisor, Joliet, Illinois, to record amount of sleep

The following are the subtitles used:

1. "Once upon a time high among the mountains, there lived a little Gnome whose duty it was to watch over the children of the earth, whom he believed to be the world's greatest treasure."

2. "From rock to rock he went peering into the world below in search of little children who needed his lesson of Health and Happiness."

3. "Sometimes he would go into caves under the earth where he loved to hear above his head the music of children's dancing feet."

4. "But now and then he would hear less pleasing sounds."

5. "Betty won't play—she's always tired. What's the matter with her now?"

6. "The Knowing Gnome:

'Betty needs the Sandman,
For ten hours of sleep each night.
Close your eyes and see him,
Making kiddies right.

'Betty must know what the Knowing Gnome knows,
To be healthy and happy from head to her toes,
If she'd drink four full glasses of water each day,
She'd learn that it helps keep the doctor away.'

7. "The Knowing Gnome:

'A jolly fellow
I'd have you meet,
As food for children
He can't be beat!'

8. "The Knowing Gnome: 'Have you ever heard of Humpty Dumpty the funniest egg ever seen?'

'Humpty Dumpty sat on a wall,
Humpty Dumpty had a great fall;
All the King's horses and all the King's men
Couldn't put Humpty Dumpty together again.'

'Humpty Dumpty crashed most to death,
Every thing gone, even his breath,
Along came the Knowing Gnome mending his frame,
By putting him back altogether again.'

9. "Bobby and Betty in one voice: 'Oh, how wonderful! Show us more of your magic.'"

(This was as much as the children could do in the twenty minutes which was allowed each day for the experiment. The story, therefore, was continued on the following day.)

Tuesday, December 12.—

10. "Watch the baby animals,
How they grow so strong
Milk their only diet
Nature's never wrong."
11. Bobby and Betty: "But why should we drink milk?"
12. "Milk is good for children,
Morning, noon and night;
Makes them strong and healthy,
Keeps them feeling right."
13. "What else is good for us?"
14. "Paddy Spinach is a fine young chap,
For every child to know,
And Charles Carrot and Sammy Bean,
Helps to make them grow."
15. "Come with me,
And by magic stealth,
I'll show you both
The Way to Health."
16. "American Red Cross. Nutrition Class. Everybody Welcome."
17. "This is the door to sturdy health,
To Happiness and Joy.
The Knowing Gnome would point the way
To every girl and boy."
18. "It takes only a few months to change Bobby and Betty into happy laughing children."
19. "Without their knowledge the Gnome watches over their daily lives and even while they sleep during hours in sweet fresh air."
20. "In the hope of finding the Gnome again, they follow the old familiar paths."
21. "If we could only thank him for teaching us how to grow well and strong."
22. "When behold!"
23. "If all little boys and all little girls
Would healthy and happy become;
And have all the pleasures and the joy
They should do as these children have done."
"And to this day from mountain heights
The Knowing Gnome still directs little children
Into paths of health and happiness."

(It may be necessary for the teacher to explain the general idea of the nutrition class. Children who are very much underweight have been placed in special classes where they are instructed in the laws of health after they have been examined by the physician to see that there are no enlarged tonsils or other physical defects.)

Wednesday, December 13.—The lesson group spent the twenty minutes reviewing the following principles which had been brought out in subtitles of *The Knowing Gnome*: (a) Children should have at least ten hours of sleep every night. (b) Four glasses of water each day. (c) Milk is a good food for children. (d) Spinach, carrots, beans, are also good for children. (e) Sleep in the fresh air.

The film group were shown the picture *The Knowing Gnome*.

Thursday, December 14.—Instead of using the subtitles as in the preceding picture, merely an outline giving the information which was to be shown in the next pictures was given to both groups.

I. Introduction

a) Types of cattle:

1. Holstein
2. Guernseys
3. Jerseys
4. Scotch Ayrshire
5. Brown Swiss

b) Care of cattle:

- | | |
|----------|---|
| 1. Food | } Balanced rations for all-the-year production. |
| 2. Water | |

II. There is no better food for animals

- a) Tell the children about experimenting with rats. Rats that have been fed upon a diet which included milk have a glossy coat, are well proportioned, and weigh more than those having the same diet with the exception of milk.

III. There is no better food for children

a) What constitutes milk:

1. Protein—Flesh-forming group, builds up the tissues of the body
2. Fats and carbohydrates—Produce and maintain heat
3. Mineral matter—Indispensable because they are constituents of every part of the body

4. Vitamines—Substances the exact composition of which is unknown but necessary for growth and health

IV. Care of milk

a) Before it reaches the home:

1. Cleanliness in the barns, transportation of milk, bottling machines, etc.

b) In the home:

1. Must be kept cool.
2. Bottle covered.
3. Ice-box clean.

Friday, December 15.—

a) Pasteurization

V. How milk can be used

a) As a drink

b) With cereals and desserts

1. Breakfast food, especially oatmeal.
2. Baked apple.

c) Cooked with other foods. "It adds to the value of practically all foods."

1. Creamed soups, vegetables, creamed fish, creamed chicken or dried beef, custards, cheese dishes, cottage cheese, milk breads

VI. Forms of milk

a) Milk, butter, cheese.

Monday, December 18.—The lesson group spent the twenty minutes reviewing the principles which had been brought out in the outlines given for Thursday and Friday. The film group saw the two films *Milk, the Perfect Food*, and *The Four M's*. (*The Four M's* is a four-minute film and could, therefore, be shown at the same time as the film *Milk, the Perfect Food*.)

Tuesday, December 19.—The following subtitles are fourteen of the nineteen in *Mrs. Brown and the High Cost of Living*.

1. "I don't see how we can make both ends meet much longer with prices as they are."
2. "It certainly is a problem. I'm reading now that lack of proper food makes children backward at school."
3. "The High Cost of Living goes to market with Mrs. Brown."
4. "I'm worried sick. My meat alone cost me two dollars this morning."
5. "I'm using cheaper cuts of meat and only five times a week at that."
6. "But your family must have proper food."

7. "My dear, we are certainly well-nourished. Come with me and I will show you how I solve the problem."

8. "This is a Red Cross Clinic in Home Dietetics. The instructor is explaining the Five Food Groups. *We need some food from each group every day.*"

9. The Instructor. "Group I. Vegetables and fruits furnish much mineral salts and other substances necessary for growth and health!"

10. "Group II are the body-building protein foods.—Meat, Eggs, Cheese, and *Milk, the Indispensable Food.*"

11. "Group III. Cereals are Building as well as Energy Foods."

12. "Group IV. Sugars and Syrups are Energy Foods."

13. "Group V. Fats are the best Fuel Foods."

14. "Nourish your body thoughtfully and it will sustain your thought."

Emphasis in this lesson should be placed upon the fact that we need some food from each group every day. Have the children go over their diet of the preceding day to see if it has included some fruit, cereal, vegetable, fats such as butter and milk.

The following are about half the subtitles of *The Romance of the White Bottle*.

1. "A fairy story based on scientific facts."

2. "The breakfast hour in a Western home among the pines."

3. "Mother Berton whose every thought was for the welfare of her little son."

4. "Johnny—more anxious to see the parade."

5. "Chance to get rid of the milk. 'I'll slip it to the cat.'"

6. "Mother: 'Why Johnnie!'"

7. "Mother: 'Drink this and then you can go.'"

8. "Mother: 'Well, go ahead. You can drink it with your lunch when you come back.'"

9. "Johnnie: 'Gee, but they're husky boys. I'm going to be a soldier when I grow up.'"

10. "An impulse to play soldier."

11. "The Family Doctor."

12. "'Where's your muscle?'"

13. "You must go home and rest. And if you wish to grow big and strong you must drink lots of milk."

14. "I'm too tired to eat now. I want to rest."

15. "Johnnie slips away into dreamland."

16. "'I'm Good Health. I'm the boy you must have been and can still become.'"

Wednesday, December 20.—This lesson began the study of fruits and vegetables in addition to reviewing the principles of the film, *The Romance of the White Bottle*. The film *Mrs. Brown and the High Cost of Living* was not shown until Thursday, December 21.

The general directions given to both groups for introducing the value of fruit and vegetables in the diet, were as follows.

1. Ask the children to name the different countries which are known by their fruits. For example: California—figs; Persia and Arabia—dates; United States—apples; Panama and Central America—bananas; Florida—grapefruit and oranges.
2. How many fruits can the children name. How many of these grow in Illinois? Which fruits are in season?
3. Name the fruits that can be used for breakfast.
4. "Fruits should be cleaned carefully before being used as a food. Even when the skin is carefully removed, it should be washed carefully. One handles both the skin and the fruit at the time of peeling." Name the fruits which are peeled before using.
5. The mineral matter in fruit including iron, phosphorus, lime, magnesia, and potash is very valuable to the body.
6. "Make a list of all the vegetables you know. Divide the list into the following groups: (a) those that may be baked; (b) those that may be creamed; (c) those that may be scalloped; (d) can any vegetable be put in more than one class?"

Thursday, December 21.—The film group saw the films, *Mrs. Brown and the High Cost of Living*, and *The Story of the Orange*. The lesson group reviewed the data brought out in the subtitles of the film, *Mrs. Brown and the High Cost of Living*. In addition to this the subtitles of the film *The Story of the Orange* were given. The following are seven of the twenty-six subtitles.

1. "Here ripe fruit is picked every day in the year."
2. "Great care has been required to produce."
3. "Two weeks later the top is cut off to force strength from roots into the bud."
4. "The result. A young tree with hardy 'root stock' and branches which will produce good oranges."
5. "After two years, leaves are cut off and trees are 'balled' for shipment."

6. "The babies (young trees) get an honest-to-goodness bath in the nursery."

7. "One hundred trees are planted to the acre. It costs over \$1,000 to bring them into bearing."

The close of the picture shows the various ways oranges can be served. The teachers in the lesson group showed pictures of oranges and at the same time discussed the value of fruit in the diet.

The health principles next emphasized deal with care of the teeth. Logically this material should have been placed first but it was felt that the material upon milk and other foods were more interesting to the children, and they were therefore placed first.

Christmas vacation came at this time. From one standpoint this was unfortunate since it did not make a continuous experiment, but from another standpoint it was very fortunate as it gave an opportunity to see, first, if the children remembered the information taught, and, second, if the information taught had any permanent effect upon the health habits of the children. The experiment, was, therefore, continued Friday, January 5.

To interest the children in the problem of the care of the teeth and to prepare them for the lessons which followed, one period was given to the composition of original rhymes. The following four rhymes are specimens of rhymes used by the American Dental Association which were given to the children as suggestions.

1. Little Tommy Tucker sing for your supper,
What can I sing for—white bread and butter?
How can I chew it, my teeth are so bad?
Get a brush and clean them, my dear little lad.
2. Where are you going, my pretty maid?
To find a dentist, sir, she said.
What is your fortune, my pretty maid?
My teeth and face, kind sir, she said.
3. Humpty Dumpty sat in a booth.
Humpty Dumpty has a bad tooth.
Only a brushing—and not the king's men
Will make his bad tooth a good one again.

4. Little Boy Blue, come blow your horn.
And brush your teeth, both night and morn.
Everybody likes a nice clean boy.
And nice white teeth are such a joy.

Monday, January 8.—The following is part of a lecture which had been prepared for children by Dr. C. R. Hoffman with the assistance of teachers. It contains the material which was shown in the next moving-picture and for this reason was given in full for the information of the teacher as to what they should teach.

The mouth is one of the most important parts of the body and yet it is the most neglected part. The mouth is the gate to health and happiness and all food must go through this gate. Food is selected first, by sight, then by smell, and last but most important by taste, and taste takes place in the mouth.

Taste is the last test that Nature has given us to use in separating good food from bad. Good food tastes good and may be swallowed; while bad food is detected by the taste and is rejected.

Horace Fletcher has said: "Every bite of food must be tasted and only that food which has been thoroughly tasted and found pleasant should be swallowed." Mr. Fletcher was a strong healthy man, sixty-one years old, when he made that statement, and has taken strength tests which showed him to be more than twice as strong as the best college athletes. Yet twenty-five years ago the doctors said he could live only a short time, and they were right because he was a sick man and would have died if he had not learned to eat in the right manner. The wonderful change in this man's health was made simply by thoroughly chewing his food until he got out of it all of its taste, then swallowing it. He sipped and tasted liquids like milk and soups.

Before food can be tasted it must be ground into very small pieces in the mouth, and the teeth are placed in the mouth to do that grinding. During that grinding and tasting of food a watery substance called saliva enters the mouth and is thoroughly mixed with the food. This saliva keeps the food and the mouth moist and changes some foods from an indigestible kind to digestible. Digestion in the simplest language is changing food into blood and the first part of this change must be done in the mouth, with the aid of the tongue, cheeks, lips, and teeth. The saliva moistens dry foods so they can be tasted, changed, and easily swallowed. . . .

In conclusion: First, decay of the teeth is not due so much to poor teeth as to uncleanness and negligence. Second, youth is the period of

geatest danger from decay. Third, you cannot estimate too highly the value of good teeth and a healthy mouth. Much individual suffering can be prevented by taking care of your teeth.

Tuesday, January 9.—The film group had the film, *Your Mouth, the Gateway to Health*. The lesson group had the subtitles which were in part as follows.

1. "Health is priceless."
2. "The food you eat is converted by digestion into life and energy."
3. "The entire digestive system is automatic except,"
4. "The Chewing Machine."
5. "The teeth are the working tools."
6. "Grind your food until it is almost liquid. It is then properly prepared for the stomach and your teeth have had the exercise they need."
7. "Tooth decay destroys the 'Food Grinding Machine.'"
8. "It also furnishes breeding places for disease germs."
9. "A minute portion of débris is removed from a tooth cavity."
10. "And incubated in an oven at body temperature."
11. "In a few hours the germs have multiplied into millions."
12. "Germs grow as rapidly in an unhealthy mouth, and billions are 'hatched' in tooth cavities and swallowed every day."
13. "The progress of tooth decay."
14. "Food remaining in the mouth starts tooth cavities."
15. "Dental decay, if neglected, will not stop until the teeth are actively destroyed."
16. "'Toothache' is Nature's last call for relief."

Wednesday, January 10.—The film group had the film *Toothache*, while the lesson group had the subtitles which were as follows.

1. "How it began. [Picture of a man trying to eat breakfast. He is seized with great pain when he tried to masticate his food. There are two children at the table, one of whom soon starts for school.]
2. "The school dentist arrives."
3. "He tells the children that 'Food left between the teeth causes decay.'"
4. "Dirty mouth breeds disease germs. Neglected mouths cause bad breath."
5. "A clean tooth never decays."
6. "Clean your mouth after eating coarse foods."
7. [The dentist illustrates the process of a decaying tooth.] "After three months."

8. "After six months."
9. "After twelve months."
10. "After eighteen months. [The teachers can illustrate this by showing on the board the loss, first, of a corner of the tooth; second, a third of the tooth; third, a half of the tooth and last the disappearance of the whole tooth.]
11. "Dental Inspection." [After the dentist had given the talk upon the preservation of the tooth, the children are shown having the inspection.]
12. "The Result of Neglect." [Picture of a boy who had not taken care of his teeth.]
13. "Record. A very bad mouth."
14. "Disease gums."
15. "Adenoids."
16. "A very good mouth. [Picture is shown of the girl whose father had had the toothache in the morning.]
17. "Teaching children how to masticate their food."
18. "How to use dental floss."
19. "Brush drill." [Given by the school nurse.]

Thursday, January 11.—The same questionnaire described on page 348 was given to the pupils.

Friday, January 12.—The children were weighed. Since there were a number who had lost weight because of vaccination, it was decided to take the weights again four weeks later, which was done in February.

THE TESTS

Monday, January 15.—The following information test was given to all the children. It was designed to cover the essentials of all the instruction which had been given during the entire period of the experiment.

TEST I

[Directions: Read each sentence and underline the word in the parentheses at end of sentence which fits *best* in the blank space of the sentence.]

1. I should go to the dentist at least ——— a year. (one, two, three, four, five, six)
2. I should drink at least ——— glasses of water each day. (two, three, four, five, six, seven)
3. I should have at least ——— hours of sleep each night. (eight, nine, ten, eleven, twelve, thirteen)

4. I should eat some fruit and vegetables at least ——— times a week (two, three, four, five, six, seven)
5. I should brush my teeth at least ——— times a day. (one, two, three, four, five)

[Time allowed for this test was thirty seconds]

TEST II

[Directions: Read each sentence and make a cross before the *best* answer as shown in the sample.]

The saying "Early to bed, early to rise" means

- a) A good appetite for breakfast.
- b) A cheerful disposition.
- × c) At least ten hours of sleep every night.

The following are the sentences:

1. Milk and meat are alike because
 - a) They contain protein.
 - b) Everybody likes them.
 - c) They cost about the same.
2. Milk is a good food because
 - a) It is easy to buy.
 - b) It comes from the farm.
 - c) It makes muscle and bone.
3. Fruits and vegetables should be eaten every day because
 - a) They act like a broom that cleans the digestive system.
 - b) They taste better than all other foods.
 - c) They are in the market.
4. The mouth is the gateway to health because
 - a) All food must pass through this gate.
 - b) It is the most neglected part.
 - c) Digestion is changing food into blood.
5. Good teeth are necessary to our health because
 - a) They are placed in the mouth to grind the food into very fine pieces.
 - b) Food is selected by taste.
 - c) Good teeth are necessary to a soldier.
6. Clean teeth will not decay because
 - a) Clean mouths will not spoil the food.
 - b) There will be no bad food in the mouth to help them decay.
 - c) There are too many.

[Time allowed for this test was one minute, fifteen seconds]

TEST III

[Directions: The words of this line are "Bowl a oatmeal of let I see." These words as they are now do not make any sense. By changing the position of the words, they will make a sentence if you cross out one word. The correct sentence is "I see a bowl of oatmeal." The word "let" is not necessary. Draw a line under it. In each of the following groups of words, by changing the order of the words, a sentence can be made by underlining one word that should be omitted. Read the sentences. Do not rewrite them but only underline the unnecessary word.]

1. Children for is milk good it.
2. Have every for proper family must food.
3. And girls to little all boys become can healthy.
4. Need from group than food some day we every each.
5. Vegetables for furnish in necessary health substances.
6. Milk desserts used to be can cereals and with.
7. From foods milk cooked be other with can.
8. We water at four drink least glasses day should each from of.
9. We our sleep out windows should with open.
10. We brush day every teeth our should at.

[Time allowed for this test was five minutes]

TEST IV

Jack's Adventure

Jack's mother was called away from home last evening at six o'clock so the family had to eat without her the dinner which she had prepared. After dinner Jack, who was eleven years of age

[Draw a line under the one which he should do]

(1) read (2) played quiet games (3) went to the movies (4) had a wrestling match with the boys.

He was tired and by

(1) seven (2) seven thirty (3) eight (4) eight thirty (5) nine (6) nine thirty (7) ten

he was ready for bed. However, when he went up stairs he found many things he wanted to do. But he decided to

(1) finish the story he had been reading (2) brush his teeth (3) get into bed as soon as he had undressed (4) go to the ice box for a lunch. (5) plan games for the boys for the following day (6) pick up his toys.

When finally he was ready for bed he

(1) opened the windows (2) telephoned the boys (3) hunted for his pet dog (4) visited for a few moments with his brother Jim.

When he turned out the light it was

(1) seven (2) seven thirty (3) eight (4) eight thirty (5) nine (6) nine thirty (7) ten (8) ten thirty.

The next morning there was no one to call Jack as his father went to work very early, but he awoke as usual at

(1) six (2) six thirty (3) seven (4) seven thirty (5) eight (6) eight thirty.

He was invited to a neighbor's house for breakfast. When he came into the house Mrs. Burnett said, "Jack, I don't know what you usually have for breakfast but we have these things in the house. I am going to let you choose *four* things from the following:

[Underline the four things Jack chose]

(1) sausage (2) fried potatoes (3) oatmeal (4) pancakes (5) cornflakes (6) milk (7) eggs (8) bacon (9) coffee (10) prunes (11) oranges (12) apples (13) tea (14) buttered toast.

Before going to school Jack went home and

[Draw a line under *two* of the following which he should do]

(1) put on his coat (2) brushed his teeth (3) picked up his clothes which were lying on the floor (4) fed his dog (5) telephoned his aunt (6) played with his radio set (7) pasted stamps in his album (8) practiced on his drum

After studying at school for an hour and a half, Jack was ready for recess. At that time he

(1) played with the boys (2) drank a bottle of milk (3) ate an apple (4) ate candy (5) teased the girls.

For the rest of the morning Jack was busy with his school work. He had made plans to meet his father at a cafeteria so that they might have lunch together. Jack had never been to a cafeteria before. Everything looked so good and Jack was hungry. His father told him he could choose, besides bread and butter, one thing to drink, and three other dishes. It was a hard task for a boy to decide what he wanted to eat, but he finally chose *four* of the following:

(1) a cup of coffee (2) a pot of tea (3) roast beef (4) spinach (5) carrots (6) weenies (7) doughnuts (8) milk (9) oranges (10) pie (11) lettuce (12) rice-pudding (13) beans (14) strawberry short-cake (15) macaroni and cheese (16) fried cakes (17) cabbage (18) creamed pea soup (19) custard.

Jack was back at school at one-thirty and by four o'clock he was ready to
 (1) curl up before the fire-place and read a story (2) play out of doors
 (3) have a lunch of candy and nuts.

At six o'clock Jack's father took him again to the cafeteria. "Well, son, what do you want to-night?" Jack thought of the things he had had at noon and finally chose *four* of the following things:

(1) roast pork (2) fried potatoes (3) stewed fruit (4) oranges (5) meat balls (6) apple pie (7) custard (8) milk (9) fried bread (10) coffee (11) one fried egg (12) tea (13) lettuce (14) spinach (15) beets (16) vegetable soup (17) peas (18) tomatoes (19) grapes.

When Jack and his father arrived home, they found that mother had returned.

[Time allowed for this test was six minutes]

TEST V

[Directions: Read each sentence and underline *one* word in parentheses at end of sentence which fits *best* in the blank space of the sentence.]

1. Cereals are —— foods as well as body-building foods. (energy, fuel, body-building)
2. Sugars and syrups are —— foods. (energy, fuel, body-building)
3. Fats are the best —— foods. (energy, fuel, body-building)
4. Meat and cheese contain —— . (protein, mineral salts)
5. Eggs are a —— food. (energy, fuel, body-building)
6. Vegetables and fruits contain much —— . (protein, mineral salts)
7. Milk is an —— food. (indispensable, unnecessary)
8. —— is a perfect food. (meat, milk, vegetables, fruits)

[Time allowed for this test was thirty-five seconds]

SCORING KEY

The following key was used for scoring the results of the tests:

TEST I

Point
Value

- (1) Two
 (1) Four
 (1) Ten
 (1) Seven
 (1) Two

[Total score for Test I was, therefore, 5 points.]

Point
Value

TEST II

- (1) Meat and milk are alike because they contain protein.
- (1) Milk is a good food because it makes muscle and bone.
- (1) Fruits and vegetables should be eaten every day because they act like a broom that cleans the digestive system.
- (1) The mouth is the gateway to health because all food must pass through this gate.
- (1) Good teeth are necessary to our health because they are placed in the mouth to grind the food into very fine pieces.
- (1) Clean teeth will not decay because there will be no bad food in the mouth to help them decay.

[Total score for Test II was 6 points.]

TEST III

- (2) If the word "it" was underlined.
- (2) "For" underlined.
- (2) "To" underlined.
- (2) "Than" underlined.
- (2) "In" underlined.
- (2) "To" underlined.
- (2) "From" underlined.
- (2) "Of" underlined.
- (2) "Out" underlined.
- (2) "At" underlined.

[Total score for Test III was 20 points]

TEST IV

- (1) Brushed his teeth.
- (1) Opened the windows.
- (1) If the difference between the time Jack went to bed and arose the next morning was at least ten hours.
- (3) If Jack had milk at each meal or at two meals and recess because "milk is good for children morning, noon and night."
- (1) If Jack had vegetables at least once during the day.
- (1) If Jack had fruit at least once during the day.
- (1) Cereal.

[Total score for Test IV was 9 points]

Point
Value

TEST V

- (1) "Energy" underlined.
- (1) "Energy" underlined.
- (1) "Fuel" underlined.
- (1) "Body-building" underlined.
- (1) "Protein" underlined.
- (1) "Mineral Salts" underlined.
- (1) "Indispensable" underlined.
- (1) "Milk" underlined.

[Total score for Test V was 8 points]

The total possible score in the test was made by adding the points on each question, which was 48, then multiplying that score by 2, thus making the total score almost 100. This score was more comparable to the Terman's Intelligence Scale which was used in the second part of the experiment.

RESULTS

An attempt to measure the results was made along four distinct lines. They are as follows: first, the increase or decrease in the weights of the children of both groups; second, the increase or decrease in the number of hours of sleep as determined by the clockfaces which were handed out each week for four weeks (this also included a record as to whether or not the children were sleeping with their windows open); third, improvement made in certain health habits as recorded by the questionnaire; fourth, the amount of information the children had gained as shown by the results of the test given at the end of the experiment.

I. THE WEIGHTS AS A MEASURE OF THE RESULTS

At first it was the intention to weigh the children at the beginning and the end of the experiment, which would represent a period of six weeks. However, since many of the children had lost weight because of the vaccination, it seemed best to take the weights four weeks after the experiment had closed, thereby extending it over a period of ten weeks. Table I shows the results of weighing the children.

It will be noted that the median gain of the lesson group was 0.245 pounds greater than that of the film group. It is 24 per

TABLE I

THE NUMBER OF POUNDS THE CHILDREN IN THE TWO GROUPS
HAD GAINED IN A PERIOD OF TEN WEEKS

Group	Number Weighed	Total Pounds Gained	Average Pounds Gained	Median Pounds Gained
Lesson group.....	277	321.8	1.162	1.250
Film group.....	345	350.5	1.016	1.005

cent of the gain of the film group. Whatever conclusions can be drawn from these figures will be presented after the other results have been given.

2. REGULARITY IN THE NUMBER OF HOURS OF SLEEP

This was determined by the clockfaces which were handed to the children each Monday for a period of four weeks. In making a summary of the results, the records of only the first and fourth week of those who had kept a daily account throughout

TABLE II

SHOWING THE NUMBER OF CHILDREN WHO HAD HAD
TEN HOURS OF SLEEP THE FIRST AND THE
FOURTH WEEK OF THE EXPERIMENT

	Lesson Group	Film Group
Total number of records used.....	150	142
Total number points possible the first week.....	1,050	994
Points gained the first week.....	743	720
Percentage of total possible points....	69.90	73.44
Points gained the fourth week.....	690	743
Percentage of total possible points....	65.71	75.76
Average points per pupil first week....	4.89	5.07
Average points per pupil fourth week...	4.60	5.25

the experiment were included in the table. Since the film and lesson given to the children taught that each child should have at least ten hours of sleep each night, this was the only point taken into account. No attention was paid to the time the child

went to bed or the time he arose in the morning provided he had ten hours. In order to reduce the results to a comparable basis a point system of grading the papers was used. Each child was given one point for each night he had slept ten hours. Thus, the total number of points each child could make was fourteen, seven being given for the first week and seven for the last week. The same method was used in tabulating the record upon the open windows.

A study of the table shows that the film group made an improvement during the experiment, while the lesson group lost.

TABLE III
SHOWING THE NUMBER OF CHILDREN WHO HAD SLEPT WITH
THEIR WINDOWS OPEN THE FIRST AND FOURTH
WEEK OF THE EXPERIMENT

	Lesson Group	Film Group
Total number of records used.....	124	142
Total number of points possible the first week.....	868	994
Points gained the first week.....	658	512
Percentage of total possible points.....	75.80	51.50
Points gained the fourth week.....	648	535
Percentage of total possible points.....	74.65	53.82
Average points per pupil first week....	5.30	3.60
Average points per pupil fourth week...	5.22	3.76

As shown in Table II, the film group made an improvement during the experiment while the lesson group lost. The results seem to indicate that there was a greater sustained interest in the film group than in the lesson group.

3. RESULTS OF THE QUESTIONNAIRES

In considering the results of the questionnaire, one must bear in mind that they assume the reliability of the children's testimony. However, generally speaking, children at this age are inclined to tell the truth, and therefore, the probabilities are that there will be as many mistakes made in the one group as in the other.

A summary of the results of the questionnaire is shown in the following table.

TABLE IV

SHOWING THE RESULTS OF THE QUESTIONNAIRE ANSWERED
BY THE CHILDREN BEFORE AND AFTER THE EXPERIMENT

	Lesson Group	Film Group
Total number of questionnaires used including first and second.....	492	700
Decrease in the percentage of those drinking coffee.....	1.63	9.14
Increase in the percentage of those drinking tea....	2.43	.....
Decrease in the percentage of those drinking tea....	.....	7.43
Increase in the percentage of those drinking milk..	0.41	5.42
Increase in the percentage of those eating cereal...	2.03	3.63
Increase in the percentage of those drinking at least four glasses of water daily.....	9.76	9.14
Increase in the percentage of those eating fruit daily	2.84	.....
Decrease in the percentage of those eating fruit daily.....	.....	0.86
Increase in the percentage of those sleeping with open windows.....	4.07	3.14
Increase in the percentage of those who learned how many hours of sleep children should have	19.11	33.29
Increase in the percentage of those brushing their teeth daily.....	7.72	7.72
Increase in the percentage of those who learned how much water one should drink daily.....	23.39	35.43

It will be noted that the results of a few questions have been omitted. The first question, for example, was more thoroughly answered by the clockfaces. Question 5 was omitted because an equal opportunity to obtain milk in the schools was not given to all the children. Questions 8 and 10 were not included in the film instruction. Questions 12, 13, and 16 were found to be too subjective, not only from the standpoint of the children but also from the standpoint of grading, and it, therefore, seemed better to omit these answers.

Questions 2 and 3 were included in the results although the danger of drinking tea and coffee was not taught in the film. They were used as a check upon the number of children who were drinking milk, as past experience has shown that when children drink milk they drink less coffee. In other words, milk becomes a substitute rather than an additional drink. The figures in Table IV seem to confirm this observation to some extent.

A more or less detailed study of the table is necessary in order to judge the effect of the motion picture. There were three films dealing with the value of milk in the diet. Therefore, one might expect that so many pictorial representations of one fact would be more effectual than a verbal review, as there would be a larger variation in the presentation of the former than of the latter method. The results of the table show that a larger number of children in the film group than in the lesson group reported that they were drinking milk.

The lesson group had a larger increase in the percentage of those who reported that they were actually drinking at least four glasses of water each day. But there was a greater increase in the film group in the number who said they *should* drink four glasses daily.

The lesson group had the larger increase in the percentage of those eating fruit daily. A detailed study of the individual cases show that the decrease in the number in the film group was found in those schools which represented the industrial class of the city. It might, therefore, be possible that the purchasing of fruit was an impossibility, especially since the questionnaire was answered a few weeks after the Christmas holidays, a period which, among this class of people, requires the strictest economy. This fact would, probably, have to be taken into consideration in considering the results.

There seems to be a discrepancy in regard to the percentage of children sleeping with their windows open, when compared with the results in Table III. This discrepancy might be due to the larger number of cases used in Table IV than were used in Table III. An effort was made to use only the data of those children who had answered both questionnaires and had kept a complete record on the clockfaces for the four weeks, but due to the vaccination, it was impossible to get a sufficient number of cases to make the data entirely conclusive. The differences in both cases are small and the discrepancy is, therefore, not important.

A larger percentage of the film group reported that they had learned how many hours of sleep and how many glasses of water

one should drink daily. There is no evidence, however, that an actual improvement was made in this group. No explanation can be given for this fact since the establishment of either principle as a health habit required no expenditure of money.

In general, both groups improved in health as a result of the instruction, but there was no conclusive evidence that one group was decidedly superior to the other at the end of the experiment.

4. INFORMATION TEST RESULTS

Table V gives the distribution of scores made by 691 pupils, together with the medians, standard deviations, and the reliability

TABLE V
DISTRIBUTION OF SCORES MADE BY 691 PUPILS
IN A HEALTH INFORMATION TEST

Score	Lesson Group	Film Group	Score	Lesson Group	Film Group
2.....	I	0	56.....	13	8
4.....	I	I	58.....	10	11
6.....	I	I	60.....	9	8
8.....	6	11	62.....	10	2
10.....	0	6	64.....	4	4
12.....	5	10	66.....	13	2
14.....	8	12	68.....	7	4
16.....	3	6	70.....	2	2
18.....	8	15	72.....	4	3
20.....	9	10	74.....	6	1
22.....	6	14	76.....	3	2
24.....	9	9	78.....	0	3
26.....	16	17	80.....	1	1
28.....	11	22	82.....	3	4
30.....	11	19	84.....	0	2
32.....	20	20	86.....	0	5
34.....	7	15	88.....	1	.....
36.....	9	7	90.....	.....	.....
38.....	13	13	92.....	1	.....
40.....	9	16	94.....	.....	.....
42.....	10	13	96.....	1	.....
44.....	12	17	Total.....	314	377
46.....	10	14	Median.....	42.8	35.732
48.....	6	13	S.D.....	9.084	9.332
50.....	13	12	S.D. median...	0.641	0.601
52.....	14	6			
54.....	9	13			

of the various medians. According to the key given on page 364 the highest possible score was 48 which was then multiplied by 2.

In the fifth-grade group, Trabue's Language Test was given. This test correlates very closely with the Binet-Simon Test and was, therefore, used as an indication of the comparable ability of the two groups. The results of this test showed that there was only about two month's difference in favor of the lesson group.

The reliability of the difference between the medians is shown in Table VI. This coefficient was calculated by the same formula as was used by James (see p. 204).

TABLE VI	
SHOWING THE CERTAINTY OF THE RESULTS	
Lesson-group median.....	42.8
Film-group median.....	35.732
S.D. difference.....	7.068
Experimental coefficient.....	1.44
Chances to one.....	Practical Certainty

Therefore, it may be stated with practical certainty that the method used in the lesson group gave a greater degree of knowledge than the method used in the film group.

5. GENERAL SUMMARY AND INTERPRETATION OF RESULTS

1. In weight, the children in the lesson group have made the greater improvement. It is difficult to say that this was due to the method of teaching, but with such a large group other factors such as physical defects, home conditions over which the children have no control, etc., tend to balance each other, as the chances are that there are just as many defects in the one group as in the other.

2. In regard to the number of hours of sleep the children had and whether or not they have slept with their windows open, the film group made the greater improvement. This might indicate a greater sustained interest induced by the film as it is difficult to interest children in any project for a period of six weeks.

3. In the questionnaire no definite conclusions can be made regarding the two groups, since neither group made a better

record throughout. The larger difference in percentage, however, favors the film group.

4. In information, the children in the lesson group made the better record. This might be due to the type of pictures which the children used as illustrative material in their health books and the films which were exhibited. The subtitles were sufficiently complete to give to the children a clear idea of the story. That the children who had *not* seen the film were able to find or imagine good substitutes for the pictures which were found in the film is shown by the following photographs. Plate II shows four pictures taken from the health book which had been made by the children to illustrate the subtitles. The subtitles used in connection with these sections of the film were as follows:

a) Upper left-hand corner: "Once upon a time high among the mountains, there lived a little Gnome whose duty it was to watch over the children of the earth whom he believed to be the world's greatest treasure."

b) Upper right-hand corner: (1) "Sometimes he would go into caves under the earth where he loved to hear above his head the music of children's dancing feet. (2) But now and then he would hear less pleasing sounds."

c) Lower left-hand corner: (1) "The Knowing Gnome:

'A jolly fellow
I'd have you meet
As food for children,
He can't be beat.'"

(2) "The Knowing Gnome, 'Have you ever heard of Humpty Dumpty, the funniest egg ever seen.'" (3) "Humpty Dumpty sat on a wall."

d) Lower right-hand corner:

"Humpty Dumpty had a great fall,
All the king's horses and all the king's men,
Couldn't put Humpty Dumpty together again."

Plate III represents the four sections of the film which the children had illustrated. Plate IV shows again the interpretation which the children had placed upon the subtitles. The following subtitles were used as a basis of the illustrations:

a) Upper left-hand corner:

"Milk is good for children,
Morning, noon and night,
Makes them strong and healthy
Keeps them feeling right."

b) Upper right-hand corner:

"This is the door to sturdy health,
To happiness and joy,
The Knowing Gnome would point the way,
To every girl and boy."

c) Lower left-hand corner: "In the hope of finding the Gnome again, they follow the old familiar paths."

d) Lower right-hand corner:

"And to this day from mountain heights,
The Knowing Gnome still directs little children
Into paths of health and happiness."

Plate V shows the sections of the film from which the subtitles were taken. It can be seen that there is very little difference in the actual health value between the two interpretations. It may be possible, because of this similarity, that the film was too simple for children of this age, although the majority of those who saw it reported that they liked this film the best. It is evident, however, that the information imparted was well within the child's comprehension since without further instruction he was able to clearly visualize it. It shows that the film did not add much to the child's knowledge.

EXPERIMENT 2

THE DESCRIPTION OF THE EXPERIMENT

I. THE SUBJECTS

While the first experiment was conducted under the conditions of the ordinary classroom, the second part was organized under more controlled conditions as a check upon the first method. One hundred and seventy children in the seventh and eighth grades of the Washington School, Joliet, Illinois, were included in the group.

2. THE FILMS

Two of the films used in the first experiment were shown. They were the *Knowing Gnome*, and *Mrs. Brown and the High Cost of Living*.



ILLUSTRATIONS TAKEN FROM THE "HEALTH BOOK" MADE BY THE CHILDREN OF FIFTH GRADE UNDER THE
DIRECTION OF MISS FREY, FARRAGUT SCHOOL, JOLIET, ILLINOIS



SECTION TAKEN FROM THE FILM, *The Knowing Gnome*
(Printed through the courtesy of the Society for Visual Education, Chicago, Illinois)

PLATE IV



SHOWING THE INTERPRETATION WHICH CHILDREN PLACE UPON THE SUBTITLES OF A FILM
The book was prepared under the direction of Miss Frey, Farragut School, Joliet, Illinois



TAREN FROM THE FILM *The Knowing Gnome*
(Printed through the courtesy of the Society for Visual Education, Chicago, Illinois)

3. METHOD USED IN EXPERIMENT 2

The week previous to the showing of the film, Terman's Intelligence Test, Form A, was given, and in the experiment the pupils were divided into the two groups upon the basis of the results of this test.

Miss Keith, supervisor of the Elementary Schools in Joliet, taught the health material contained in the two films to the lesson group. The subtitles were first read to the pupils, then the important health principles were written upon the blackboard and reviewed. The time consumed by the lessons was exactly the same as that taken by the films. There was no illustrative material used.

The film group were shown the films immediately after the lesson group had received their lesson.

The information test given to the fifth grade in Experiment 1 and described on pages 360 ff. was the method used to test results, but only those points involved in the two films counted toward the score. The total possible score was 88.

RESULTS

Table VII shows the comparison of the results of the test.

It can be seen that these results seem to corroborate the results obtained in Experiment 1, that the method used in the lesson

TABLE VII

SHOWING THE SUPERIORITY OF THE LESSON GROUP OVER
THE FILM GROUP IN THE INFORMATION TEST

	Number of Pupils	Median Intelligence Score	Median Information Score
Lesson group.	82	62.00	59.05
Film group.	88	62.36	57.82

group gave a slightly greater amount of knowledge than the method used in the film group.

CONCLUSIONS

1. The results do not favor in any marked degree either group. The probable effect of the film instruction does not warrant the expenditure of the amount of money involved in the rental of such films as are available at the present time.

2. The films used were apparently more entertaining than instructive and did not emphasize to a sufficient degree the *formation* of proper health habits. The fact that the children were not accustomed to the use of films as a part of the regular procedure in the classroom may have had its influence upon the results. Before definite conclusions in regard to the benefits derived from film instruction can be made, however, it is necessary to have films produced which are more adaptable to classroom use.

CHAPTER XIII

AN ANALYTICAL STUDY OF THE CONTENT OF EDUCATIONAL MOTION PICTURE FILMS

H. Y. McCLUSKY

The objective of this study was to secure accurate information on the composition of a large number of representative educational motion picture films. These films were secured from two sources: the Society for Visual Education, of Chicago, and the Educational Museum of the Cleveland School of Education. The films were inspected by running them slowly through a measuring machine and by recording the number of feet for each strip of action picture, still picture, or subtitle. The proportion of the film devoted to each of these three types of material was carefully computed.

Any portion of the film containing printed matter for the explanation of scenes and the sequence of presentation was regarded as subtitle material. Scenes in which there was no overt action, such as views of the open country, mountains, buildings, portraits, were recorded as still pictures. A scene containing running water or rising smoke was interpreted as action. Any section of the film containing motion in any significant part of the scene was regarded as action picture. There was no separate classification for charts and diagrams. Charts showing no alteration after the initial presentation were regarded as still pictures. Cartoons showing animation or exhibiting shifting legends, bars, lines, or pointers were interpreted as action pictures.

The measurements and interpretations were made with extreme care; the analysis of each film required approximately forty-five minutes. In case of uncertainty, in many instances the film was projected when a motion picture machine was available.

TABLE I

THE PERCENTAGE OF FOOTAGE OF 100 EDUCATIONAL FILMS DEVOTED
TO SUBTITLE, STILL, AND ACTION PICTURES

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action	Total Length in Feet
Rivers (Atwd).....	3.95	4.7	91.35	935
Bold Shore (Atwd).....	5.44	.....	94.56	625
Low Shore (Atwd).....	6.66	.....	93.34	855
Formation of Geysers (Atwd).....	11.67	.....	88.33	591
Limestone Caves (Atwd).....	12.00	.....	88	565
Power Farming No. 1.....	12.04	.....	87.96	1,052
Asilomar beside the Sea.....	13.23	6.43	80.34	839
War Review No. 2.....	13.58	.....	86.42	724
War of Revolt.....	14.38	3.83	81.79	966
Coral Growth (Atwd).....	15.03	.....	84.97	419
War Review No. 1.....	15.4	.....	84.6	982
Ship Building No. 3.....	16.56	2.86	80.58	489
Struggle of England and France for America	16.71	17.88	65.41	766
Growth of Cities.....	18.14	18	63.86	821
English Settlements.....	18.92	77.38	3.7	597
Breaking through Appalachians.....	18.92	23.72	57.34	490
Romance of Hardwood No. 1.....	19.22	15.63	64.65	1,030
History of the Washing Machine.....	19.24	.....	80.76	842
Electro-Magnetism No. 1.....	21.53	.....	78.47	952
Dairy Cattle No. 2.....	21.62	25.21	53.17	1,059
Romance of Hardwood No. 2.....	22.3	.....	77.7	1,031
Rocky Mountains.....	23.29	20.38	56.33	712
Great Plains.....	23.29	13.4	63.31	485
Mississippi Trails.....	24.31	7.38	68.31	839
Middle Atlantic States.....	25.29	32.23	42.48	937
Earth and the Worlds Beyond.....	25.65	28.26	46.9	842
Immigration.....	26.35	21.31	52.32	929
Oranges No. 1.....	26.35	8.15	63.5	908
Story of Zinc.....	26.4	1.81	71.79	769
Dairy Cattle No. 3.....	26.46	1.91	71.63	1,043
Guardian of the Columbia.....	26.57	25.14	48.29	843
Pacific Mountains and Lowlands.....	26.83	31.25	41.92	723
Across Rockies to Pacific.....	27.33	17.47	55.2	578
Representative Democracy.....	27.73	9.07	63.20	685
Ohio Valley.....	27.94	13.11	59.06	816
Louisiana Purchase.....	28.47	5.86	63.67	597
Mesa Verde.....	29.25	50.46	20.29	1,070
Lure of Lake Erie.....	29.33	.8	69.87	992
Wall Paper.....	29.39	.....	70.61	674
Steel No. 13.....	29.69	8.48	61.88	943
Citizen and His Government No. 1.....	29.69	.8	69.87	889
New England No. 2.....	29.90	37.3	33	973
Behind Scenes in a Hotel.....	30.00	3.57	66.43	821
Keep the Boy on the Farm No. 1.....	30.99	5.16	63.84	910
Oleomargarine.....	30.99	20.02	49.89	802
Jupiter's Thunderbolts.....	31.00	1.5	67.48	867
Irrigation (S.V.E.).....	31.00	40.5	28.48	920
Canning Electricity.....	31.28	5.52	63.26	815
Middle Atlantic States No. 1.....	31.45	15.28	53.27	903

TABLE I—Continued

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action	Total Length in Feet
Making Shoes No. 2.....	31.58	.....	68.42	880
Mount Cavell.....	31.93	22.27	45.80	880
Dairy Cattle No. 4.....	32.50	22.00	45.50	1,000
New England No. 1.....	32.85	19.83	47.32	968
Keep the Boy on the Farm No. 2.....	32.86	.....	67.14	890
Canals in United States History.....	34.00	8.97	57.30	919
Pottery.....	34.27	8.90	56.83	814
Keep the Boy on Farm No. 3.....	34.31	1.92	63.77	883
Electro-Magnetism No. 2.....	34.78	.....	65.22	690
Unhooking Hookworms.....	35.25	10.53	54.22	987
Niagara.....	35.43	.....	67.57	745
Citizen and His Government No. 2.....	35.61	.....	64.39	834
Western Plateau.....	35.75	32.80	31.45	881
Cancer No. 1.....	36.17	12.51	51.32	879
Making Shoes No. 1.....	37.28	.....	62.72	979
Central Plains No. 1.....	37.47	7.64	54.89	523
Virgin Wool.....	38.56	4.79	56.65	918
Carborundum.....	38.80	.....	61.20	683
Knights of the Saddle.....	38.81	.....	61.19	496
Railroads in United States History.....	38.81	12.6	48.58	992
Central Plains No. 2.....	38.98	.....	61.02	808
Poland China Swine.....	39.10	.....	60.90	911
High Frequency Current.....	39.10	.....	60.90	924
Panama Canal No. 9.....	39.69	13.00	47.31	776
Where Plants Live.....	40.18	52.85	6.97	876
Lathe No. 1.....	40.55	6.49	47.04	863
Granite-Quarries.....	40.67	8.29	51.04	627
Lumbering in North Woods.....	41.30	2.09	56.61	954
Electrostatics.....	42.18	.....	57.82	915
Wild Geese.....	42.28	1.28	56.41	629
Southern States.....	42.41	20.22	37.37	613
Wasps.....	42.58	9.84	47.58	904
Shrimp Fishing.....	42.93	4.41	52.66	566
Mid-Summer Wild Plants.....	43.04	56.96	0.00	748
Honey Bee.....	44.14	10.77	45.09	863
Bee Culture No. 4.....	45.14	5.26	49.60	855
Bee Culture No. 3.....	45.48	2.45	52.70	897
Milk No. 18.....	45.81	13.73	40.46	801
Diphtheria.....	46.19	4.51	49.30	775
Hats Off to the Flag.....	46.34	.....	53.66	807
Bee Culture No. 1.....	46.53	14.24	39.03	823
Animated Geometry No. 2.....	46.62	11.86	41.52	978
Growth and Cultivation of Dates.....	48.50	1.70	49.80	530
Some United States Workshops.....	48.52	.90	50.77	787
Pond and Stream Life No. 2.....	48.93	10.29	40.78	846
Green Bottle Fly.....	50.64	19.18	31.18	855
Irrigation (Ford).....	50.95	22.47	26.58	783
Biscuit-Making.....	52.28	9.77	37.95	941
Dairy Management No. 1.....	52.70	8.38	38.92	1,038
Animated Geometry No. 1.....	53.75	12.18	34.07	878
Bee Culture No. 2.....	54.90	10.26	34.84	867
Average.....	32.08	11.19	56.73	.....

With these precautions and this method, one hundred films were analyzed. The following table shows the results of the analysis of each film as well as the average results for the group. In Table I the films are arranged from the lowest to highest as measured by percentages of subtitle material.

Properly regarded, the six films marked "Atwood" occurring at the first of the list in Table I are not representative educational films. In each case the films represent Dr. Atwood drawing a diagram of some geological formation. There is little distinctive scenery, very meager explanatory material, and only the action involved in drawing a chart. These films might justly be omitted from the computation of the group averages. The following table is introduced at this point with this suggested elimination of the Atwood pictures.

TABLE II
THE PROPORTIONS OF SUBTITLE, STILL, AND ACTION
PICTURES IN 96 EDUCATIONAL FILMS; OMITTING
THOSE MADE BY PRESIDENT ATWOOD

	Average
Percentage subtitle.....	33.54
Percentage still.....	11.85
Percentage action.....	54.61

The following discussion will be based on the revised averages of Table II.

These simple figures relate a condition which few persons realize. The very term "*motion*" picture implies that the film is composed for the most part of action material. But these averages, based on the films contained in two of the best educational motion picture libraries in the country, refute the common notion by indicating that only slightly more than half of the usual educational film is devoted to pure action. And the results of McClusky's analysis of other films¹ show that if all charts and diagrams were rigidly excluded from the category of action picture the actual amount of motion would be much less than half the entire film.

¹ Chap. i.

The implication of these facts is so patent that misinterpretation would be difficult. About half of the standard film dealing with educational topics is composed of material inherently no different from the photographs and reading matter which constitute the common textbook. This presence of still pictures and explanatory reading matter cannot be defended on the ground that it presents material otherwise inaccessible; for attractive illustrations and descriptive reading are available for almost any section of the world that the film deals with. Furthermore such a lavish application of the film to printed material and straight scenes cannot be supported for reasons of economy; for the construction of a film entails more expense than the purchase of suitable texts or illustrated pamphlets. Finally the film is short lived when compared to printed matter.

Table I shows very clearly that many films are constructed in good proportion with only a minimum of printed explanation and actionless scenes; for obviously some verbal explanation is essential to supplement the pictures. But Table I also proves that mal-proportion is present in too many cases. In order to show to what excess this disproportion can go, a number of more extreme cases are selected from Table I and grouped together in Table III.

This selection of extreme cases points out in a striking way the disproportionate amount of non-motion material that is present in so many educational films. In this group slightly more than a fourth of the film is devoted to action pictures! The highest proportion is given to plain photographs (still pictures) and almost equally as high a percentage is devoted to printed matter!

Let us single out some of the conspicuous extremes in Table III. Take, for instance, the film entitled *Where Plants Live*. Only 6.97 per cent is action picture; over half (52.85 per cent) is a series of photographs of flowers, weeds, vegetation, and habitats; two-fifths (40.18 per cent) consists of reading matter. Mark another example, *Mesa Verde*. Half of it consists of a rapid succession of scenes of the southwestern part

of the country and most of the 20.29 per cent action is so by virtue of the fact that a member of the photographic party happened to cross and appear at various times in the sweep of the camera. Scarcely any action is there which is indispensable for the understanding of the film.

Observe the extreme case of film folly: *Mid-Summer Wild Plants*—not an inch of action! There are 43 per cent of exposition and 57 per cent of a series of photographs—either or both

TABLE III

A GROUP OF FILMS SELECTED FROM TABLE I TO SHOW EXAMPLES OF
IMPROPER PROPORTION BETWEEN SUBTITLE AND STILL
PICTURES AS CONTRASTED WITH ACTION PICTURES

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action
English Settlements.	18.92	77.38	3.70
Middle Atlantic States.	25.29	32.23	42.48
Pacific Mountains and Lowlands.	26.83	31.25	41.92
Mesa Verde.	29.25	50.46	20.29
New England No. 2.	29.90	37.30	33.00
Irrigation (S.V.E.)	31.00	40.50	28.48
Western Plateau.	35.75	32.80	31.45
Where Plants Live.	40.18	52.85	6.97
Southern States.	42.41	20.22	37.37
Mid-Summer Wild Plants.	43.00	56.96	0.00
Pond and Stream Life No. 2.	48.93	10.29	40.78
Green Bottle Fly.	50.64	19.18	31.18
Irrigation (Ford)	50.95	22.47	26.58
Average.	36.38	37.22	26.4

of which are just as accessible in illustrated books and far more conveniently and economically obtainable in this way. These instances serve to portray the absurd disproportions to which careless film construction leads.

Let us now examine the various kinds of topics that educational films deal with and observe the proportion of subtitle, action, and still pictures common to each type.

For this purpose there follows a series of five tables, IV–VIII inclusive, and two summary tables combining the results of the more detailed tables.

Section A of Table IV shows that there are some films exhibiting processes of manufacture which are so theoretical as to require a large amount of subtitle material. Section B indicates that most of the films of this type measure high in action pictures. Most manufactured articles undergo a definite series of steps in their construction; this type of activity is particularly well adapted to portrayal through the medium of the film, for it can

TABLE IV
THE PROPORTION OF SUBTITLE, STILL, AND ACTION
PICTURES IN FILMS SHOWING PROCESSES
OF MANUFACTURE

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action
Section A			
Biscuit Baking.....	52.28	9.77	37.95
Oleomargarine.....	30.54	19.57	49.89
Lathe No. 1.....	40.55	6.49	47.04
Average.....	43.12	11.94	44.96
Section B			
Virgin Wool.....	38.56	4.79	56.65
Story of Zinc.....	26.4	1.81	71.79
Carborundum.....	38.8	.....	61.2
Wall Paper.....	29.69	.....	70.61
Steel No. 13.....	29.69	8.48	61.88
Making Shoes No. 1.....	37.28	.....	62.72
Making Shoes No. 2.....	31.58	.....	68.42
Average.....	33.1	2.154	64.75

rarely be adequately explained in any other way except by sheer demonstration.

In all of the films mentioned in Table V, narration was used to bring out the essential points of the subject. This requires a large amount of action picture (61.21 per cent) with comparatively little still picture (5.14 per cent). Some of the topics are so technical or involve so much explanation that a large amount of subtitle is introduced to explain the action; for this point notice the averages of the films, *Hats Off to the Flag*, and *Diphtheria*.

Table VI shows that films of regional geography contain the highest percentage of still pictures of all types of films. These pictures are largely a series of scenes representative of the section of the country portrayed. Too often the action material is not

TABLE V
THE PROPORTION OF SUBTITLE, STILL, AND ACTION
PICTURES IN FILMS EMPLOYING THE STORY
FORM OF PRESENTATION

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action
Struggle of England and France for North America.....	16.71	17.88	65.41
Keep the Boy on the Farm No. 1...	30.99	5.16	67.31
Keep the Boy on the Farm No. 2...	32.69	.....	67.31
Keep the Boy on the Farm No. 3...	34.31	1.92	63.77
Hats Off to the Flag.....	46.34	.....	53.66
Diphtheria.....	46.19	4.51	49.3
Citizen and His Government No. 1...	29.69	.4	69.91
Citizen and His Government No. 2...	35.61	.....	64.39
Representative Democracy.....	27.73	9.07	63.2
Average.....	33.74	5.14	61.21

TABLE VI
THE PROPORTION OF SUBTITLE, STILL, AND ACTION
PICTURES IN FILMS OF REGIONAL GEOGRAPHY

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action
Mount Cavell.....	31.93	22.27	45.8
New England No. 1.....	32.85	19.83	47.32
New England No. 2.....	29.9	37.3	33.
West Plateau.....	35.75	32.8	31.45
Southern States.....	42.41	20.22	37.37
Middle Atlantic States No. 2.....	25.29	32.23	42.48
Pacific Mountains and Lowlands....	26.83	31.25	41.92
Average.....	32.137	27.985	39.905

only insignificant but merely consists of some irrelevant movement across the field of the camera. And by the very nature of regional geography, the subject does not provide much opportunity for a definite and discernible sequence. The rather high subtitle average (32.137) is the result of an attempt to accompany the scenes with a large amount of detailed description.

Table VII indicates the presence of a large amount of subtitle material in films dealing with agricultural geography. The topics almost invariably require a large amount of supplementary

TABLE VII
THE PROPORTION OF SUBTITLE, STILL, AND ACTION
PICTURES IN FILMS OF AGRICULTURAL GEOGRAPHY

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action
Irrigation (S.V.E.).....	31	40.5	28.48
Irrigation (Ford).....	50.95	22.47	26.58
Bee Culture No. 1.....	46.53	14.24	39.0
Bee Culture No. 2.....	54.9	10.26	34.84
Bee Culture No. 3.....	45.48	2.45	52.7
Milk No. 18.....	45.81	13.73	40.46
Dairy Cattle No. 1.....	52.7	8.38	38.92
Dairy Cattle No. 4.....	32.5	22.	45.5
Honey Bee (Ford).....	44.14	10.77	45.
Growth and Cultivation of Dates...	48.5	1.7	49.8
Average.....	45.25	14.64	40.05

information since each process exhibited is presumably unfamiliar to the spectator. On the other hand, whatever action does appear in films of this type is usually extremely significant and difficult to portray in any other way.

TABLE VIII
THE PROPORTION OF SUBTITLE, STILL, AND ACTION
PICTURES IN FILMS OF BIOLOGY

Title of Film	Percentage Subtitle	Percentage Still	Percentage Action
Pond and Stream Life No. 2.....	48.93	10.29	40.78
Green Bottle Fly.....	50.64	19.18	31.18
Wasps.....	42.58	9.84	47.58
Mid-Summer Wild Plants.....	43.00	56.96	0.00
Where Plants Live.....	40.18	52.85	6.97
Average.....	45.066	29.824	25.302

Table VIII brings out the fact that films on biological topics are difficult to construct with much significant action. The averages indicate an unusually large proportion of the film devoted both to subtitle material (45.06 per cent) and still

pictures (29.82 per cent). One of the worst examples of film-making occurs in this group *Mid-Summer Wild Plants*, where no action appears. Judging from the facts contained in these averages, one would suppose that biological topics were not especially adapted to the medium of the film; but it is probably more true that the possibilities of the motion picture as a teaching device is least developed in biology as far as can be ascertained from the films of this study.

In order to facilitate a comparison between the various types of films used, a table of averages (Table IX) and a figure was constructed. (In order to avoid repetition of the figure the reader is referred to Figure 28, page 63 which represents Table IX graphically.)

TABLE IX

THE PROPORTION OF SUBTITLE, STILL, AND ACTION PICTURES
IN FILMS OF VARIOUS TYPES CLASSIFIED ACCORDING TO
SUBJECT-MATTER AND MANNER OF PRESENTATION

Type of Film	Percentage Subtitle	Percentage Still	Percentage Action
Manufacturing processes (B).....	33.1	2.154	64.75
Story presentation.....	33.74	5.14	61.21
Regional geography.....	32.137	27.98	39.905
Manufacturing processes (A).....	43.12	11.94	44.96
Agricultural geography.....	45.25	14.64	40.05
Biology.....	45.06	29.824	25.302

Table IX provides a ready comparison of the proportion of subtitle, still, and action pictures constituting the various types of educational film topics, and facilitates a rapid survey of the averages in Tables IV-VIII inclusive.

The types, "processes of manufacture (A)" and "agricultural geography," demonstrate a similar tendency. These types deal with processes which are more or less unfamiliar and which cannot be easily explained merely through scenes involving activity. The danger in this kind of film is that it shall overload the progress of the continuity with excessive information and thus detract from the presentation of the essential idea of the film. The action material is usually significant but not sufficiently obvious to carry itself without much supplementary comment.

In the groups termed, "regional geography" and "biology" the subtitle material is quite liberal (45.06 per cent and 32.137 per cent), the proportion of still pictures is unusually large (27.9 per cent and 24.8 per cent), while there is a comparatively small amount of action. These two types contain the worst examples of educational film construction.

The films of the groups "manufacturing processes (B)" and "story presentation" contain few still pictures, an average amount of subtitle, and a large amount of action pictures. It appears, then, that these two forms of material are best adapted to the medium of the motion picture film.

There may be some objection on the ground that the criterion of the proportion of subtitle, still, and action pictures is not sufficient for an adequate estimate of the educational value of a film. This argument undoubtedly has point, but that this criterion of proportion is important can scarcely be denied. There can be little justification for devoting 600 feet of still pictures and subtitle as a background for 100 feet of action. The background may conveniently be procured in other ways (illustrated text, charts, lecture, demonstration, etc.) and the film is too costly where substitutes, equally effective, are available. If the small amount of action shown is extremely significant, it might be exhibited in conjunction with the minimum of necessary explanatory captions.

The length to which this excessive use of still pictures and subtitle material can go is illustrated by a film (entitled *English Settlements*) mentioned in Table III. This film is composed largely of still pictures; it deals with a historical subject, not by presenting a story especially dramatized for this film, but by offering a series of historical views and a succession of portraits of pioneer personages no better than those adorning the wall of the ordinary schoolroom. There is scarcely any action; in fact there is nothing exhibited in the film essential to the topic which requires activity for its portrayal.

These excesses appear to be the result of the uncritical opinion that any type of educational material, by some mysterious

alchemy, becomes a desirable educational device when placed on a motion picture film. On the contrary the facts of this study indicate that the educational film per se has no inherent virtue, and that to serve its function, it must be as rigidly constructed and skilfully conceived as the finest textbook or the finest type of screen drama.

That the educational film has a province is undoubtedly true. As already implied, its purpose is to record those processes which contain significant activity, difficult to portray in any other way except through its actual representation. Furthermore, it has a large place in dramatizing historical episodes and sketches from literature where specially prepared background and action is employed to the uttermost. Nor is it too sanguine to predict its effective adaptation to subjects where it has already failed. For instance it is conceivable that very short films of plant tropisms, the circulation of blood in a frog, or close-up views of birds and animals would serve a purpose which no other device can possibly fulfil.

The conclusions of this study may be summarized as follows:

1. Of the usual educational film as now constructed, about one-half is given to action pictures and the other half consists of still pictures and subtitles.

2. A selection of extreme cases shows that this disproportion is more accentuated in many instances.

3. The films exhibiting processes of manufacture and story presentation take most advantage of the special merits of the film.

4. It is a waste to devote so much film for mere photographs and printed matter which are available in other forms.

5. The composition of educational films must be as critically and scrupulously and intelligently undertaken as the construction of any other educational device or any screen drama.

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